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A LETTER FROM Dr. *James Walkinshaw* TO *Sir* Robert Sibbald.

LONDON,

Printed in the Year 1709.

LETTER

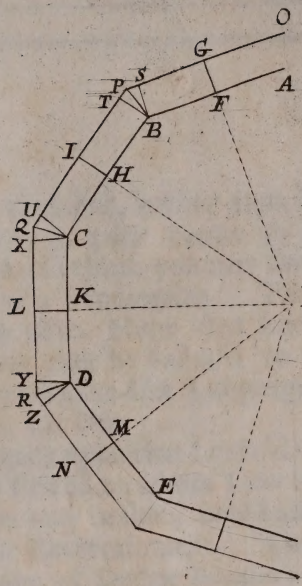


Fig. 1.

Fig. 2

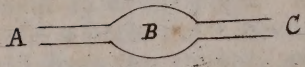
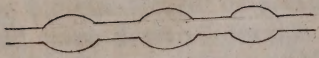
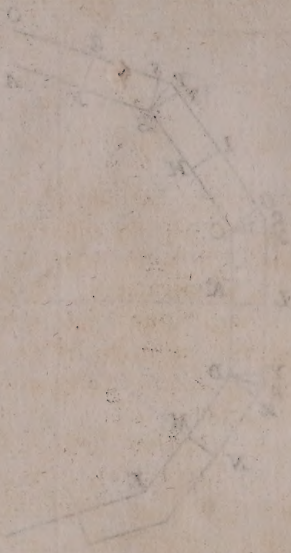


Fig. 3





SIR,

I Have seen the Libel, rather than Letter, falsly written in your Name to Doctor *Pitcairn*: And I think you may save your self the Trouble of a Vindication. The Sham is too gross to take. None that knows Sir *Robert Sibbald*, can ever be induc'd to believe that such Ungentleman-like Language could have dropt from his Pen.

So Rude an Attack upon that Learn'd Gentleman, my worthy Friend, to whom I ow so many Obligations, you may be sure, could afford me no very agreeable Entertainment. 'Twas provoking to see one of Doctor *Pitcairn's* Merit, so scurvily us'd; And without Indignation, one could not bear so foul Language thrown upon his Friend, almost in every Page. Had the Author but shew'd a little more Civility, he might have differ'd from the Doctor, as he pleas'd, and Wrote against him too, to the World's End for me; Nor should you have been troubled with Reading, more than I with Writing these hasty Reflexions which I send you, and which nothing but the Height of Incivility to my Friend could have drawn from me.

If I have happen'd to shew any thing of Keenness, you'll the more readily Excuse it, that

You know that it is far from my natural Way. Tho' the Occasion was Provoking, 'tis what I have endeavour'd to avoid; And if after all, something of this kind still appears, 'tis owing to nothing but the wretch'd Pattern that lyes before me while I'm writing. Some Things are of that pestiferous Nature, that they cannot be Touch'd without Infection, and bad Books are like bad Company, if we Study the one, or Frequent the other, insensibly we draw in the Poison, and some thing sticks to us in Despite of all the Caution we can use.

As to the Author, You'll perhaps be surpriz'd, when I tell you, we have a Gentleman in this City, who tho' he does not speak it out, yet all along has acted such a part in this Scene, as if he seem'd to court the Honour of the scoundrel Performance, and were pleas'd to be thought Author of it, without his saying it. Tho' Poor and Wretch'd as it is, it has happen'd a little unluckily for him, to be set off with a Mathematical Figure or two, and the Appearance of some little Mathematical Reasonings and Calculations: And whether upon that Account, I know not, but the honest Gentleman has the Misfortune to be believ'd by most People to have no more Title to it, than to some other Things of greater Value, which some time ago he would have pass'd upon the World for his own, if the World would have believ'd him. But 'tis an unbelieving World we live in, and some People too well know, there were Things there exceeding his Ways of Thinking: And tho' they had lost of their Lustre through course

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Handling, and the course Stuff that was blended with them, 'twas still easy to discern whence they had been taken. 'Tis indeed strange, one should so boldly adventure upon Stealing, that has not the Skill to go about it more handsomly, nor the Conduct to Manage what he Steals to better Purpose. For he did but botch and confound all, did but spoil and sully some good Thoughts pick'd up from others, with impure Mixtures of his own (God knows what) sad and fulsom Stuff; of which it were easy to give a particular Detail, if it were needful: But the Books themselves are publick, and the Intelligent Reader has but to Read and Consider them, compar'd with Pages 83, 84, 85, and 86. of Doctor *Pitcairn's Dissertation De Legibus Historiæ Naturalis*, and be satisfied of the Truth of what I say: For I design to confine my self to the Libel that lyes before me.

The true Author of which, it seems, has thought to ly cover'd, or under his Friend's foolish Conduct, or under your borrow'd Name; tho' generally People here make as little doubt about him, as ye do in *Scotland*. And were there no Presumption from other Matters of Fact, as there are some very shrewd ones, 'tis Alledg'd, the Piece it self bears the true Stamp of it's Author: That saucy Magisterial way, that Pride and Vanity, that gross Rudeness, that Scurrility and Spite, and these other Peculiarities of the unmannerly Stile that reigns through the whole, are not to be Match'd every where. Such as are best seen in our Modern Writings, know not where to find the Parallel, but in the late

Works of a certain Gentleman, if he deserves that Name, who was not asham'd to distinguish himself by Treating some of the best and greatest Men of this and former Ages with an Insolence unbecoming either Gentleman or Scholar.

For what tho' he could prove some Escapes or Mistakes upon them? Is it so very extraordinary a thing for a great Man sometimes to make a Slip; or so very surprizing for a very ordinary Man to perceive it? That, when it comes in his Turn, he must assume such Airs of Superiority, and must think himself priviledg'd to Treat far better Men than himself with what Disdain and Contempt he pleases to put upon them?

For my Part, I know no Pretension great Men have to Infallibility, more than others of an Inferior Understanding. They may indeed, when they set themselves about it, do things far exceeding the Reach of ordinary Men, but still they are subject to the common Infirmities of humane Nature; and are not Angels, more than the poorest Peasant. They cannot at all times (as we say) have all their Eyes about them, nor all the remote Consequences at once before them, which may be drawn from what they are advancing. They have their own weak Sides, and are lyable to their own little Prejudices and Passions, as well as other People. And there's no doubt, but that, when they have their Heads surcharg'd with a great many things together, something may escape their Notice, which a very indifferent Man, with little in his Head to distract his Thoughts, may easily observe; Or

that

that when their Fancy is heated in the Pursuit of a Notion, that's agreeable to some little present Bias, they may be misled into Mistakes, which one of far less Penetration, but unbiass'd and in cold Blood, may easily see will not stand the Test; Or that, when they are tir'd out and exhausted after long and painful Researches, they may be even forc'd to unbend and relax, and to indulge themselves for a while in a looser way of Thinking. Or perhaps to recreate their wearied Spirits, they may be glad to sit down, and amuse themselves with a little innocent Romance in Philosophy, as others do in Love, while at the Bottom they well enough know, there is perhaps as little Reality in the one, as commonly is in the other. But what of all this? Why? An honest Man would thank them heartily, would honour and respect them for their other good Services, would easily over-look Slips of a lesser Nature, that draw no hurtful Consequences after them; would not grudge them their inoffensive ingenious Diversion; Or, if he found Mistakes of greater Moment, there's no doubt, but that for the common Service of Mankind and of Truth, he would be oblig'd to take Notice of them: But then he would take care to do it with that Civility and Respect, which is due to Persons of their Distinction: And when so gone about, 'tis an Office, which, no doubt, the greatest Man wou'd accept, and thankfully acknowledge, from the meanest. But to pass over all the good things we ow them, without the small Tribute of a cheap Acknowledgment, and in stead of this, to

fall

fall foul upon them, Dead or Alive to revile and reproach them, without distinction, for a few Instances of humane Frailty, is a piece of Inhumanity, I believe, few but our Author could have been guilty of. Pardon, *Sir*, this short Excursion. 'Twas a Debt I could not but take this Occasion to pay to the Memory of some of these honourable Worthies, who cannot now speak for themselves; and to whom, for all the uncivil Usage our Author has shew'd them, We unquestionably ow the Foundations of those noble Superstructures, which are now so justly the Admiration of all the World.

But to come to my Friend, *if* it has been his mishap among others to fall under the Lash of this Gentleman's Pen, I know no Reason he has to be asham'd of some of the honourable Company he is joyn'd with; or to take it ill, he should meet with no better Usage than they. For 'tis not enough that what he has said is more surely founded, and may be better sustain'd, than some Philosophical Opinions, which they more unwarily advanc'd, as I hope to shew in the following Defence. Some People don't write for the sake of Truth, but right or wrong, true or false, if possible to expose the Person, that is the Butt of their Spite or Envy. And Demonstration it self is not secure against Malice, as long as Words may be wrested, or an unfair Consequence obtruded. Nay, if there's but a Typographical Error left, one that's upon that Lay will be sure to catch at it, and charge it upon the Author. If things themselves are

too

too well secur'd, to be disprov'd, He'll fall nibling and cavilling at the outsides and Circumstances of them: And twenty other oblique ways must be tak'n to lessen what cannot be destroyed. But such little Artifices are more noisy than hurtful. They may perhaps for a while surprize some weak People into a low Opinion of Persons or Things; when with equal Judges their own merit will support them to the end of the World; and the Blow, that was intended against others, will rebound upon, and end in the hurt of no Body but him that offer'd it.

Upon which Account, I should be sorry, if the *Doctor* should sit down to throw away his Time (which he knows how to bestow to far better Purposes) in an inglorious Scuffle with one so far beneath his Notice; especially since there are so very few of the many useful Truths advanc'd and establish'd by the *Doctor*, which the Libeller has dar'd directly to impugn; and the Objections he has brought against these few are so very inconsiderable, that every indifferent Reader may, without much Assistance, easily satisfy himself about them. Or if the *Doctor* will take that Part upon himself, in the new Edition of his Dissertations, which I hear he shortly intends, and will submit to the Trouble of taking off the apparent Force of some little Reasonings, that seem more directly to make against a few of his Propositions, 'tis the utmost length I think he should go. To dip further in the pitiful Quarrel, and pursue the Libeller through all the Cavils and idle Impertinencies

nencies, which make up the Body of his Book, in my humble Opinion, is altogether unworthy of the Doctor. But for once I'll try it for him.

In the very Beginning of the Libel, we have a Swatch of the Author's Spirit. The first seven Pages (tho' he would put another Face upon it) seem to be written with no other View, but to expose you as well as *Doctor Pitcairn*, and to rip up old Mistakes betwixt ye. In which howsoever, I hope, he shall find himself disappointed, since I'm confident, ye are now long ago satisfied on both sides, they were but Mistakes maliciously rais'd, and fomented by some officious People (much of our Author's Stamp) that wish'd well to neither of ye, and therefore they ought for ever to be buried in Oblivion: And I'm glad to understand, that in stead of wid'ning your Differences, this Attempt has rather serv'd to improve and confirm your Friendship together. Only give me leave to observe, That after he has put two or three Pitiful trifling Quibles in your Mouth (far beneath you, or any Man of Sense) about the Notions of a *Problem*, and *Angle*, the Signification of *Densus*, and the Transcriber or Printer's Negligence in omitting the Word *Reciproce* in a Proposition cited from *Sir Isaac Newton*, *&c.* and dismist you with that cold Defence for your self; He brings you in full of Zeal and Passion for the Honour of *Doctor Cockburn*, loading him with Praises, with high-flown Speeches, and extravagant Complements; and outragiously falling foul upon *Doctor Pitcairn*, for but doing Justice to *Bellini*, and Himself, against the modest

and

and discreet *Doctor Cockburn*, who (*Pag.* 8.) *is not asham'd to praise* Bellini *more than himself, even when he is amending him*, &c. In which Character, I believe, every Body but our Author, instead of Modesty and Discretion, will find the utmost Height of Arrogancy and Vanity. Sure I am, it would turn some People's Stomachs but once to see *Doctor Cockburn* stated in a Comparison with *Bellini*; or to hear our Author so foolishly and impudently assert, that the *Doctor* has really solv'd his Problem, about the proper Doses of vomitive and purgative Medicines: When 'tis found in daily Practice, that some Children require as great Doses as their Parents, and of two Persons of the same Weight and Temperament, as far as can be inferr'd from all the Indications we have, the same Dose that powerfully works upon the one, will not work upon the other. And tho' to the Weight of the Body he should join that of the Mind, and it's Thoughts too, according to the excellent Doctrine of his *OEconomia Animalis*, *Pag.* 113, I'm affraid he'll but little mend the Matter, 'twill be as bad Physick still, as it is Philosophy or Divinity, to which nothing can be more contrary, than attributing Weight, and consequently Materiality and Mortality to the Soul.

But here observe, how he seeks and creates to himself the Occasion he has taken to throw Scandal upon the *Doctor*, by putting these Words at the foot of *Pag.* 8. in another Character, *You took it for a Banter, and an Undertaking too great for the Capacity of a Man*, He would have the Reader to infer they were the *Doctor's*

Words, that he might thereby force Room to have a Fling at him; whereas the Doctor could no where have Occasion to speak of that Problem, it being posterior to all his Writings, as the Libeller himself owns in the very beginning of the same Paragraph.

By this time, Sir, I doubt not but you are satisfy'd, had it not been for the great Doctor *Cockburn*, Doctor *Sibbald* should never have been consider'd by our worthy Author. But for my part, I believe he should have done a great deal more for the Vindication of Doctor *Cockburn's* Honour, if instead of those fulsom Complements, which he put upon him under your Name, he had given a pertinent and distinct Answer to the Charge that Doctor *Pitcairn* brings against him in the above-cited *Pages* 83, 84, 85, and 86. of his *Dissertation*, *De Legibus Historiæ Naturalis*. For which he had all the Reason in the World, since 'twas but to do himself Right against the Injury that was intended him by Dr. *Cockburn*, in so freely making use of his Papers, and very Words, as his own, without ever acknowledging the *Doctor* for them. So that in all this Matter, not Doctor *Pitcairn*, but Doctor *Cockburn*, was the first Aggressor. And for the Libeller himself, I truly believe Doctor *Pitcairn* never so much as Injur'd him in his Thoughts, unless he takes it for an Injury, that the *Doctor* did not only entertain kindly Dispositions to himself, but took all occasions in his absence, to do good Offices, especially in his own Employment, to his neareſt Relations, as has been often acknowledg'd

ledg'd by themſelves, and could not be unknown to him.

But it ſeems the Libeller was ſenſible 'twas too hard a Task for him to anſwer the Charge: *Hinc illæ lachrymæ*; And therefore wiſely indeed he declines it, but wickedly takes himſelf to Lyes and Reproaches, where he has nothing elſe to ſay. After the Scandal but juſt now mention'd, I ſuppoſe you'll not be Surpriz'd at his next, That Doctor *Pitcairn* has *vice verſa* turn'd Pilferer from Doctor *Cockburn*, and ſtoln from him the Experiment about the *Cantharides Phil. Tranſ. N.* 252. *Pag.* 161, which is a notorious Falſhood in Matter of Fact. For to my certain Knowledge it ſtands thus. Mr. *Boyle* had prov'd, there was no Acid in Men; and Doctor *Pitcairn* from the Conſideration of the Actions of the Stomach, and Circulation of the Blood, common to all Animals, eſpecially as accounted for by Himſelf, very reaſonably inferr'd, there could be none in any other Animal. To confirm which Inference by Experiment, he caus'd diſtill ſome *Cantharides* before Doctor *Cockburn's* fulſom Paper was ſeen, as is well known to many in *Edinburgh*; for the Matter was no Secret there, but freely communicated to ſeveral both Phyſicians and Apothecaries: And in the Experiment, as it is narrated by the *Doctor* himſelf, in his *Diſſertation*, *De opera quam præſtant Corpora Acida*, &c. we have the ſeveral Proportions of *Spirit*, *Salt*, &c. which are in the *Cantharides*, and which, after Mr. *Boyle's* Invention, was the only *Deſideratum* in that Affair, tho' Doctor *Cockburn* thought fit not to take

so particular Notice of them in his Paper, to prevent Suspicions of Theft. For, after what I have said, I leave it to the Reader, whether it is more reasonable to believe Doctor *Pitcairn* was Pilferer from Doctor *Cockburn*, or Doctor *Cockburn* did not rather make bold with Doctor *Pitcairn's* Experiment, as he had done before with his Books and Manuscripts. For I'm much mistaken if Doctor *Cockburn* was not at *Edinburgh* after that Experiment was made; and tho' I should be Mistaken in this, it was easy for him to have had Account of it from some of his Correspondents there. Let me observe to You by the by, that, what *Doctor Cockburn* says in that fine Paper of his, about the External use of *Cantharides* and *Camphire*, is design'd against the ingenious Doctor *Groenvelt*, and is such Stuff as is worthy of *Doctor Cockburn* only, and the Club that endeavour'd to defame that worthy Person.

Now, after the silly Defence he has made for his Friend, comes our little Champion next to Act Offensively, and to make Reprisals upon *Doctor Pitcairn's Dissertations*. But I hope to satisfy You he has succeeded no better in the last than in the first Attempt.

The first thing he Attacks (*Pag.* 10.) is the *Doctor's* Method for determining the Curve made by the Section of a Distractile Canal with a plain Perpendicular to its Axis. And here he has shew'd the Cunning of an insidious Cut-throat, more than the Bravery of a generous Enemy. He found the Transcribers or Printers had spoil'd and mangl'd the Place, and sneak-

ſneakingly reſolv'd to make the beſt of his Opportunity, leſt he ſhould not have found ſuch an Advantage again. But that you, Sir, and every candid Reader may judge for your Selves, and not rely upon the Faith of my ſingle Aſſertion, I ſhall Tranſcribe the Words themſelves, *Pag.* 28. *Line* 4. of the *Doctor's Diſſertations*. They are theſe; *Ut hæc inveniatur facillime, Curva repræſentetur per infinitas numero Rectulas, in quas cadant Perpendiculares longitudine æquales, repræſentabunt hæ lateralem Fluidi preſſionem: verum (quia hæ omnes faciunt cum ſe invicem Angulos) productæ neceſſario concurrent. Quare res eo deducitur, ut inveniatur Curva, cujus omnes Subtangentes in puncto concurrant. Norunt autem omnes Geometræ hanc eſſe ſolum Circulum. Ergo Fluida quæcunque ſibi permiſſa neceſſario formabunt Canalem, cujus omnes Sectiones ad Axem Perpendiculares erunt Circuli.* Whereas the the true Reading ſhould be; *Ut hæc inveniatur facillime, Curva repreſentetur per infinitas numero Rectulas* æquales, *in quas cadant Perpendiculares longitudine æquales, repræſentabunt hæ lateralem Fluidi preſſionem: verum (quia hæ omnes faciunt cum ſe invicem Angulos* æquales) *productæ neceſſario* in puncto *concurrent. Quare res eo deducitur ut inveniatur Curva, cujus omnes Perpendiculares in puncto concurrant. Norunt autem omnes Geometræ hanc eſſe ſolum Circulum. Ergo Fluida quæcunque* vi Cordis propulſa,& *ſibi* deinde *permiſſa, neceſſario formabunt Canalem, cujus omnes Sectiones ad Axem Perpendiculares erunt Circuli.* Let me ask you now, are not theſe Corrections ſo natural and eaſy, that what is left found of the Diſcourſe, could have led any Body to them that

that understood the Subject? Especially, might not the Libeller have spar'd his Criticism upon the Word *Subtangentes*, since it stood Corrected, and the true Word *Perpendiculares* was restor'd in its place in the Printed List of *Errata*? And tho' it had not been Corrected to his hands, since it was *Perpendiculares* in the Premisses, could there be one so dull, as not to see it behov'd to be *Perpendiculares* in the Conclusion also? And of all the Omissions I have supply'd, is there any one Word, that ev'n Malice it self can alledge I have thrust in of Purpose or Design, to force or wrest the rest into any other Meaning than they plainly suppos'd or requir'd, to compleat the Sense? And will not therefore the judicious and honest Reader easily ascribe these Omissions to the Transcriber or Printers. For 'tis not the first good Book that has suffer'd in their Hands. And I must tell you, 'twas not the Author's own Manuscript that went immediately to the Press, but Copies of it Transcrib'd by other Hands, and sent to *Holland* to the Care of some People there, whom he thought he might safely Trust, since the hurry of his other Business could not allow him to Collate and Revise them Himself. And 'tis easy to Conceive, how either in Transcribing, or Printing, a few Words may have been omitted or mistaken; For my part, I rather Wonder that there are not more, when the Author's Eye was not over them. And I doubt not but the Word *Subtangentes*, which could not in Transcribing so easily be Mistaken for *Perpendiculares*, has been officious-

officiously thrust in by some of these entrusted, perhaps young Students in Mathematicks, as (in their View) a Word importing more Learning than *Perpendiculares*, which was common. Nor am I sorry the *Doctor* has met with this Bite: I hope it will teach him, as it shou'd do every Body else, either to take the Trouble upon Himself to Revise and Oversee what he intends for the Publick, or to consider better of fit Persons to do it for him.

Thus having, as I hope to Satisfaction, vindicated the Passage in Controversy from the injury of Transcribers and Printers; I come next to defend it so restor'd against the Cavils of the Libeller. And after the but now mention'd Criticism about *Subtangentes*, first he tells us, "Tho' the Doctor has prov'd, that the *Perpendi-* "*culars* will meet, it does not from thence fol- "low, that they must all meet in one and the "same Point; and unless this be prov'd, he can- "not demonstrate the Section to be a Circle: "*That he* seems indeed to assume without a De- "monstration, That Perpendiculars can fall "from one Point on all the Parts of the Curve, "and that they are of equal lengths: *But is not this to assume the very thing he would demonstrate?* I Answer: The *Doctor* neither assumes that Perpendiculars of equal length, can fall from one Point on all the parts of the Curve; nor, because the *Perpendiculars* will meet, does he infer they must meet in one Point, but from the suppos'd Equality of the *Rectulæ* representing the Curve, and of the *Perpendiculars*, suppos'd to fall from without upon the said *Rectulæ*, justly he Concludes

cludes these *Perpendiculars* to be inclin'd to one another at equal Angles, and therefore that produc'd they must meet in one and the same Point, and so as the Productions of them from the *Rectulæ* or Curve to the common Point of Concourse must all be of equal lengths; and consequently the Figure of the Section Circular. The Doctor's studied Brevity could not allow him to enlarge upon the Demonstration of a thing so easy, That every little School-Boy, who has but read the first Elements of *Euclid*, could make it out for himself. But if our Geometer will needs have a Demonstration, he shall not want it.

Let then (*V. Fig.* 1.) *AB*, *BC*, *CD*, *DE*, *&c*, be the equal right Lines representing the Curve: Upon their middle Points raise (outwards) the equal Perpendiculars, *FG*, *HI*, *KL*, *MN*, *&c*, representing the equal Lateral Pression of the Fluid. Over the Extremities of those Perpendiculars draw Parallels to the right Lines representing the Curve. And upon account of that Parallelism, and the Equality of the said Perpendiculars, the outward Figure, *OPQR*, *&c.* will be exactly similar to the inward, *ABCD*, *&c*, that is, the Angles, *OPQ*, and *ABC*, *PQR*, and *BCD*, and so furth, will be Equal: And as *AB*, *BC*, *CD*, and so furth, are equal among themselves, So will be *OP*, *PQ*, *QR*, and so furth, be equal among themselves. Whence 'tis manifest, That if from the several Angles of the inward Figure, *ABC*, *BCD*, *CDE*, *&c.* we let fall Perpendiculars upon the outward Parallels, *viz.* *BS*, *BT*, *CV*, *CX*, *DY*, *DZ* *&c*, all the little Lines *SP*, *PT*, *VQ*, *QX*,

QX, YL, LZ, &c. will be equal among themselves, and consequently all the little Trapezia $SPTB$, $VQXC$, $YLZD$, &c. will be both similar and equal. But every little Trapezium is similar to its respective greater, *viz.* $SPTB$ to $FBH\Pi$, $VQXC$ to $HCK\Pi$, $TLZD$ to $KDM\Pi$, and so forth: And therefore as all the Angles SBT, VCX, YDZ, &c. are equal among themselves, so will be all the Angles, $T\Pi H$, $H\Pi K$, $K\Pi M$, &c, equal among themselves. And as all the Lines, SB, BT, VC, CX, YD, DZ, &c, are equal each to other; So all their Similars in the greater Trapezia, *viz.* the Lines, $F\Pi$, ΠH, $K\Pi$, ΠM, &c, must be equal each to other; and consequently the several Perpendiculars, GF, IH, LK, NM, &c, produced, must meet in one and the same Point Π, equidistant from all the little right Lines, representing the Curve, that is, the Curve must be a Circle, *Q.E.D.*

But now the Libeller Complains, that the *Doctor* should Assume "That equal parts of these "Perpendiculars will represent the Pressures on "the Sides of the Canal, that is, *should* assume the "Lateral Pressures to be every where equal. But "how (*asks he*) is that to be prov'd? I am sure "it is not true, if the Axis of the Canal ly in "a Horizontal Position, and the Fluid be left to "it self; that is, if it have no Pressure, but "what arises from its Gravitation, as (*he says*) the *Doctor* supposes in his Demonstration. 'Tis very true, the Doctor assum'd the equality of the *Perpendiculars*, to represent the Lateral Pressure of the Fluid, and he had good Reason so to do, when that Pressure must be equal, where the

Sides of the Canal are Soft and Flexible, and the Fluid is Propell'd through it by any given *Vis*; as is the case of the Heart and the Blood Vessels. And 'twas but a fraudulent Misrepresentation of the Doctor's Sense to Interpret *Fluida sibi permissa*, by *Fluids left to themselves*, that is, *which have no Pressure, but what arises from their Gravitation*, as he would have the *Doctor* to suppose in his Demonstration. Sure I am, there was not a thought of Gravitation in his Mind, but of the Impulse of the Heart driving the *Fluids* through the distractile Canals, without respect to their Gravity: And by *sibi permissa* is plainly understood nothing else, but that, tho' we shou'd suppose the Canals of themselves lying flaccid, with their Sides clapp'd together, or form'd into any other Figure; Yet after the Action of the Heart, the Blood thrust into, and propell'd through them, would of it self, without any other Assistance, distend them into Cylindrical or Conical Figures, so as their Sections Perpendicular to the Axis should be Circular.

Thus having warded off the first Assault, 'tis time to take care of the second, which *Pag.* 12 he forms against the Doctor's excellent and never enough to be admir'd Doctrine of the Continuity of the Veins with the Arteries. But for all the Triumph, he thinks himself so sure to carry, from the Instance of the Spleen, I doubt not to make it appear to every ingenious Reader, that it is *ante victoriam*, and that neither he, nor any Body for him, will ever be able to disprove that charming Speculation. But first I must tell him, he is either guilty of unpardonable Malice, for endeavour-

deavouring to give an unfair Repreſentation of it; or of unaccountable Ignorance, for not underſtanding what the *Doctor* has expreſt with ſo much Life and Vigour. For, to put it in Engliſh to him (becauſe it ſeems he does not underſtand the Doctor's *Barbarous*, that is, *Ciceronian* Latine:) The very Soul of that Doctrine turns upon this preciſe Point, That the whole Animal Body, Fleſh, Membranes, Bones, *&c.* is but one Canal or Tube, branch'd out, divided and ſubdivided into an infinite Number of Ramifications, carrying a Fluid propell'd through them by the force of the Heart. Which Tube, as it paſſes by different parts, as by different contrivances 'tis wreath'd up into different Bowels and other Animal Inſtruments, or in different parts ſerves for different uſes, is called by different Names: Juſt as the ſame River is called by different Names, from the ſeveral remarkable Places it waters or paſſes by. Such parts of it as carry out the Fluid from the Heart to the Extremities are the *Arteries*; and the Recurv'd Arteries, carrying back the Refluent Fluid from the Extremities to the Heart, are nothing elſe but the *Veins*; and the Fluid in the Arteries and Veins is the *Blood*; and the out-goings and returns of it, from and to the Heart, is what we call in a reſtrain'd and limited ſenſe the *Circulation* of the Blood. For the Blood is a mixt Fluid, and in its out-goings from the Heart at ſeveral places Diſcharges ſeveral leſs compounded Liquors, through other Ramifications of the Arteries, which from their general uſe are call'd *Glands* or *Secretory Veſſels*, and are diſtinguiſh'd

by particular Names, according to their Situation, or different Liquors which they derive, or different uſes for which that Derivation is made. Such are the *Nerves*, the *Miliary Glands*, the *Liver*, and *Ductus Choledochi*, the *Pancreas*, and *Pancreatick Duct*, the *Seed Veſſels*, the *Reins* and *Ureters*, *&c.* Some of theſe Glands, or Secretory Veſſels refound their Liquors into the Maſs of Blood again, as the *Lymphatick*, which Diſcharge their *Lymph* into the returning Veins: Others derive their Liquors quite out of the Body, as the Miliary Glands, the Liver and Pancreas, *&c.* and theſe have their Mouths open to the outer Surface of the Body. For the inner Surface of all that great Canal, which in one continu'd Duct reaches from the Mouth to the Anus, is as much external to the Animal, and contiguous to the common Air, as is the Skin of our Hands and Faces. Nor need I to be miſunderſtood, when I ſay, the Liver, or Pancreas, or other Glands, derive or refound their Liquors. 'Tis plain, I mean the Secretories of theſe Glands, which are but Branches of the Arteries, which together with Nerves and Veins compoſe the Body of the Glands. So that as the whole ſolid parts of the Body make but one continu'd hollow Tube; in like manner, all the Liquids do but make up one mixt Fluid, for the Watering and Nouriſhment of that Tube: And what is within or without that Tube, is only properly ſaid to be within or without the Body. Imagine now the Heart to Act, and Set all this fluid Maſs a going, and you ſhall have the full and adequate notion of the Circulation of the Blood

While

While all is moving, part of it is thrust out of the Body (never again to be refounded) by the Emissaries of the Glands, which terminate with open Mouths upon the outer Surface, the rest going and returning from and to the Heart in a perpetual Circle. No separate Cisterns there for standing Pools, nor Stagnation any where, but in the Case of an Obstruction, which is a Disease, or Preternatural state of the Tube or Fluids. And here now we are presented with a noble View of the Animal Body, that renders the Circulation, as it were, visible to our Eyes, or palpable to our very Fingers; with one of the greatest Wonders of the Material Creation, with one of the best Arguments for the Infinite Wisdom and Power of the Supreme Contriver. For who does not see that such an Engine exceeds all the Powers of Mechanism? And before that Notion of one Tube, and one Mass of Fluids in that Tube (which we ow to the great Genie of Dr. *Pitcairn*, and for which alone, tho he had done nothing else, his Name deserves to be deriv'd down to Posterity with immortal Honour) the Circulation of the Blood was never rightly understood, was but an imperfect and unfinish'd Thing. And 'tis no wonder People reason'd wrong about it, while it stood as the great *Harvey* left it. 'Twas no wonder that, while the Arteries and Veins were restrain'd to the narrow Sense of these Days, People shou'd have imagin'd to themselves solid Parts, Cisterns or Vessels, that were distinct from, and no Parts of the common Tube, and Liquors in these Vessels or Cisterns that were no Parts of the common Mass;

Or

Or that thence should have sprung the Doctrines of Ferments, and differently Figur'd Pores, which the Doctor so elegantly and effectually disproves, in this admirable *Dissertation*, *De Circulatione Sanguinis per vasa minima*. And while he was shewing the Absurdity of these Doctrines, it was necessary for him to Argue upon the Principles which they suppos'd, or imply'd. For there are but two ways possible betwixt two Tubes to interpose a third Tube or Vessel, so as one Fluid, without Extravasation, may pass through all three. Either at the two Junctures of the Middle with the Extremes, the Extremities of the one must pass for some way, how little soever, into the Cavity of the other. In which Case, if the Vessels are hard and rigid, the Fluid may indeed be propagated through all three; but if soft and flexible, Dr. *Pitcairn* has Prov'd, and the Libeller agrees, it cannot be done, because of the Obstruction that must happen to the Tube, or Tubes, which in that Case will hang loose into the Cavity of the others. Or, at the said Junctures, the Middle with its respective Extreme terminates in one common Orifice, thus. (*Vid. Fig.* 2.) And then it is but one Tube, and we have the Continuity which the Doctor pleads for, and proves from the Obstruction that must happen in the only other Case. And therefore the Libeller was in the wrong for the scornful Reflexion he makes at the head of *Pag.* 14. "But this (*viz.* "*Of the one's hanging loose within the other's* "*Substance*) is a Supposition, that I be-"lieve no Body will make besides your Self, "and

" and you wou'd do it only to make way for " your Demonſtration againſt it. For, as was ſaid, in Flexible Canals, there is but that one Caſe beſides Continuity. 'Tis eaſy to forſee and obviate the only poor little Shift the Libeller has left to him. He'll perhaps tell us, That 'tis true indeed, if the middle Tube be of the ſame Subſtance with the two Extremes, they'll make but one Tube. But if the one Extreme, as *A*, is an Artery, the other *C*, a Vein, and the middle Tube *B*, a piece of Fleſh or Bone; (and why not of Glaſs or Flint?) Tho' in a certain Senſe it may be ſtill ſaid they make but one Tube, yet he may Alledge it cannot be properly ſaid, that the Vein is Continuous to the Artery, ſince 'tis disjoin'd therefrom by the Interpoſition of a Tube of another Subſtance. And truly, I believe, this is a third Caſe, which, to the World's end, wou'd never have enter'd into Dr. *Pitcairn's* Head: Nor can I gueſs what ſhou'd have brought it into the Libeller's, if it was not to have another Fling at the Doctor. Pray, good Mr. Libeller, where did you ever hear or ſee an Example of any ſuch Contrivance from the Anatomy of a ſound Body? Or, tho' you did, as in Diſeas'd and Old People the Arteries in ſome Places are ſometimes found Oſſifi'd (and ſo have I ſeen my Self the Coats of ſome of the *Sinus*'s of the Brain:) Do you think for this, the Oſſifi'd part ceaſes to be an Artery? Or wou'd you ſay one Part of the Artery is join'd to the other by the Mediation of an hollow Bone? Truly this wou'd be a way of ſpeaking of your own. As long as

the

the Man lives 'tis an Artery ſtill, tho' a vitiated One, that is, 'tis a Veſſel carryiug Blood from the Heart to the Extremities. But why all this Nicety? When you profeſs your Self of the ſame Mind with the Dr. in the reſt of the Veſſels, it wou'd really give one the Spleen, to ſee you diſcord with him only about the Bowel of that Name. Are your difficulties about it ſo inſuperable, That to avoid them, you wou'd depart from that Uniformity and Simplicity of Contrivance, which together with the Dr. you acknowledge all the reſt of the Body over. I'll ridd you of them at a leſs Expence. Do but look to Dr. *Keill's* Account of the Spleen in his little Treatiſe of Anatomy, P. 65, You'll find *the Spleen is compos'd of an Infinity of Membranes, which form little Cells and Cavities of different Figures and Bigneſs, which Communicate with one another, and which are always full of Blood.* And in the next Page, *The Spleen has Arteries from the Cœliack, whoſe Capillary Branches make frequent Inoſculations upon the Membranes of the Cells. Its Veins, whoſe Extremities communicate with the Cavities of the Cells, as they come out of the Spleen, unite and make the* Ramus Splenicus *of the* Porta. Now, pray, reflect a little, and where the Anatomiſt's hand muſt ſtop, pleaſe but to Reaſon a ſtep further with Dr. *Pitcairn*: And tell me then, what can theſe Membranes be, which form the little Cells communicating with one another, which are alwayes full of Blood, and into which the Capillary Branches of the Cœliack Artery carrying the Blood to the Spleen, and of the *Ramus Splenicus* carrying it back from it, are ſo frequently

Inoſcu-

Inoſculated. Certainly, not only Dr. *Pitcairn*, but a very ordinary Proficient in theſe Studies, from that Contrivance wou'd readily infer, theſe Membranes cou'd be nothing elſe but the *Productions* or *Propagations* of the Coats of the ſaid Blood Veſſels, form'd by a thinner Texture of their Filaments ſpread out into a larger Surface; and the Cells nothing elſe but the very ſame Blood-Canals dilated or expanded into a greater Wideneſs in the Form of Veſicles. And therefore, 'tis no wonder they ſhou'd be alwayes full of Blood. And ſuch of theſe Cells as carry the Blood outward from the Heart, or forward in the Arterial Duct, are in the moſt ſtrict and proper Senſe Arteries, as thoſe of them are Veins, which carry it backward towards the Heart, or into the Branches of the *Ramus Splenicus*. Since they all of them, not only do make but one continu'd Duct, but the Coats of that Duct alſo are Compos'd of the ſame very Filaments; with this only Difference, That they are ſometimes more, ſometimes leſs cloſely gather'd together. If it is ſaid, there are Muſcular or other Fibres interwov'n with them in the Coats of theſe Cells: So are they alſo in the Coats of all the other Blood Veſſels. Nor can I ſee any thing now further wanting for the Libeller's full Satisfaction in this Matter: For I cannot imagine He'll be ſo Abſurd, as to Alledge, That either Artery or Vein ſhou'd loſe its Nature, only for being Dilated into a greater Capacity, and gather'd together again into a leſſer Channel; Or even for any Number of ſmall Arteries ſpreading and interweav-

ing their Filaments with the Filaments of any Number of ſmall Veins to Compoſe the Coat of one greater Veſicle, into which the Arteries pour their Blood: For if the ſpringing Veins carry all that Blood backward towards the Heart; and none of it is carried further than the Extremity of that Veſicle reckon'd from the Heart, that Veſicle, for all its Bigneſs, is an Evaneſcent Artery, or beginning Vein. For an Artery is not ſaid to be Evaneſcent, or a Vein to be Naſcent, becauſe of its Minuteneſs, but for the Direction's being chang'd. Where ever the Tube is Recurv'd into a Courſe back towards the Heart, there is an Evaneſcent Artery, or ariſing Vein, tho' as big as my Finger: But if the ſaid Veſicle, after 'tis gather'd together again at its remoteſt Extremity, ſhoots out Branches, that is, Arteries, carrying the Blood on to yet greater Diſtances from the Heart, that Veſicle is an Artery, not yet arriv'd at Evaneſcence, part only of its Blood being carry'd off by the little Veins which ſpring from it by the way. And the Body of the Spleen is nothing elſe but a Texture of Threeds of Arteries and Veins, much of the Form repreſented by this Figure, (*Vid. Fig.* 3.) interwov'n with Nerves, Muſcular Fibres, and ſome few Lymphaticks.

And now after ſo full and plain Account of this Matter, I leave it to the Reader to judge, whether the Libeller had Reaſon for the fine Speech he makes, *Pag.* 12. *I like a Demonſtration that diſproves Matter of Fact; but notwithſtanding your Demonſtration, that it is impoſſible, we are certain*

certain that there are Veins and Arteries, that are not immediately conjoin'd, but there is a Large Space, Body or Interſtice *between them. Perhaps you'll wonder at the Aſſertion, but I hope to make it plainer and eaſier to be believ'd, than you have made your Demonſtration, that it is impoſſible. I ſhall inſtance in the Spleen,* &c. I won't refuſe but the Doctor had good Ground to wonder at the Aſſertion: But I'm confident neither the Doctor, nor any Body elſe is ſatisfi'd he hath perform'd, or ever will be able to perform, what he Undertook; unleſs he calls a Part of the ſame Tube, expanded to a larger Cavity than that of the two adjacent Parts, the *Large Space, Body or Interſtice* between the one Part and the other. But that is unfair Dealing, and, as I ſaid above, either a wilful Miſrepreſentation, or an unaccountable Miſtaking of the Doctor's Meaning, who never deny'd but that a Blood-Veſſel might be widen'd and contracted again into a ſmaller Tube; nor ever dream'd the wider Part could be call'd *a Space, Body or Interſtice* interpos'd betwixt the two ſmaller Parts. And cou'd it ever enter into one's Head, in the Caſe of an *Aneuriſm*, to think or call the dilated or widen'd Part of the Artery, *a Large Space, Body or Interſtice* interpos'd between the adjoining ſmaller Parts. The *Space, Body or Interſtice*, which he ſpeaks of, and diſproves, is ſomething diſtinct from, and no Part of the common Tube of the Arteries and Veins, as the Abettors of the Doctrines of Pores and Fermentations, before the Circulation was better underſtood, falſly ſuppos'd their Glands to be. Let his own

Words justify him. In the 17 Paragraph of his above cited *Dissertation*, Pag. 29. he sayes, *Ex hisce etiam deduco, inter arteriam evanescentem & nascentem venam, nullum intercedere spatium corpusve, quod possit, aut pro partium poris, interstitiisque, aut pro glandula haberi*, &c. And below in the same Page and Paragraph; *Neque enim interjacet glandula illa Poristarum media inter venam arteriamque orificiis porisque pro loci diversitate figura differentibus, aut fermentis instructa, sed glandula illa secretionibus inserviens est pars ejus canalis qui venam arteriamque efformat*, &c. Can the force of Words express a Thing more plainly? I agree with the Libeller *Pag.* 13. *'Tis something surprizing to observe the different Casts of Mens Heads*, but I refer it to the Reader, whether Dr. *Pitcairn's* or His has been Cast in the better Mould. And whether the Account I have here given of the Spleen from the Doctor's Principles, is not more distinct and intelligible, more agreeable to Mechanism, and more consonant to the Simplicity and Uniformity of the whole OEconomy, than that of his wrapt up in vague and general Terms, *viz.* By *Large Pores*, in the stretch'd *Surface* of an unknown *Body* or *Substance*, into which, according to Him, the smaller *Capillaries* are *Inoculated*: Which is no better than the antiquated Stuff of *Substantial Forms*, or the exploded Jargon of *Occult Qualities* and *Materia Subtilis*, at which he has so heartily laugh'd Himself on other Occasions.

But 'tis now time to follow him to *Pag.* 14, where he would fain laugh at the *Simplicity* of the Doctor's general Theory of *Secretion*, which he accounts

counts for, from the easy Principle of the different Diameters or Orifices of the Secerning Ducts. But the Objections he brings against it, *Simple* as it is, in the next *Pag.* 15, are indeed so wretchedly Silly and Ridiculous, that I'm almost asham'd either to repeat them, or to form any Answer to them. He alledges, 'If this were all 'that's needful to explain Secretion, there 'could be no Secretion of any simple Fluid, 'besides that which consists of the finest Parts; 'and that there can be no Secretion of the 'grossest Fluid, whose Parts compose the 'Blood. For its Particles having the largest 'Diameters, whatever Orifice admits them, 'will admit all the rest of the Particles of the 'Blood, whose Diameters are less; consequently they entering with the largest, there can 'be no Separation, and the Fluid Secern'd will 'be of the same Nature with the rest of the 'Blood. And to the same Purpose, at the end of this Paragraph, *Pag.* 16. He adds, 'It necessarily follows, there can be no Liquor Secreted from the Blood this way, but what must 'be thinner than the Blood it self. But there 'are several Liquors Secreted, that are thicker 'than the Blood; Therefore (*says he*) it is 'plain, that your (*the Doctor's*) Hypothesis is 'not sufficient to explain Secretion. Fine Reasoning indeed! I tell him a great part of the finer Parts, which compose the Blood, may be carried off by smaller and finer Vessels, before the rest of it arrive at the Orifice of the Duct appointed for the Secretion of the grosser Fluid; and what yet remains of the finer Parts

to enter the Orifice of that Duct, together with the groſſer, may be afterwards deriv'd from it, in what Proportion he pleaſes, by Ramifications ariſing from the Body of the ſaid Duct, in different Proportions, ſmaller according to the different Size of the Particles needful to be carry'd off; that the remaining Fluid, what by the groſſneſs of the Particles which are left, and what by the extreme ſlowneſs of the Motion that muſt happen in theſe long and winding Canals, may acquire, if he pleaſes, a much greater Degree of Thickneſs than the Blood it ſelf, whoſe Parts are broken and kept ſeparate by the Rapidity of the Stream in the Arteries and greater Veſſels, while under a more languid Motion in the Secretories, they have time to coaleſce and unite without Diſturbance. And hence it is, that the *Liquidum Nervorum* is among the moſt viſcid, as well as moſt ſlowly moving Liquors of the Body, tho' it has generally been believ'd otherwiſe. And as to what he ſubjoins to the foot of *Pag.* 15.

'Then next for the Fluids that are of a mean 'Thickneſs between the greateſt and the leaſt, 'they muſt conſiſt of all the Particles that are 'in the Blood, whoſe Diameters are leſs than 'that of the Orifice of the Secerning Duct, 'and they will be mixed in the ſame Proportion, 'that they were in the Blood before Secretion. 'For the Blood being every where uniformly 'mixed, all the different ſorts of Particles will 'arrive at the Mouths of the ſecerning Ducts, 'in the ſame Proportion that they have to one 'another in the Blood before Secretion, and

all

all enter, whose Diameters are less than the Diameter of the Secreting Ducts; Therefore the different Particles that compose the Secreted Fluids, must have the same Proportion to one another, as they had in the Blood before Secretion. By no means does it follow; For the parts that are smaller than these of a mean Thickness, may in different Proportions be dispos'd of, either before arriving at, or after entering into the Secretory destin'd for deriving the Parts of a mean Thickness, just as was said before of the thickest or grossest Parts, with respect to all that were finer. What answers one answers both Cases. I'm asham'd to insist further in a Matter so plain and easy. And indeed 'tis a Scandal to see one put such Confidence in so trifling a Difficulty, as if it were insuperable, when it can be no sooner propos'd, but the Answer must be obvious to any Body that knows but a little of the Animal OEconomy. And the Scandal is so much the greater still, that this Matter has been expressly consider'd and accounted for, much after the same way as I have here done, long ago by Dr. *Morland Phil. Transf. Numb.* 283. and lately by Dr. *Keill* in his *Account of Animal Secretion*, &c. And now after all this fine Reasoning of the Libeller, I would have you, Sir, to consider, whether there was Reason to subjoin the civil Complement he bestows upon the Doctor, in the middle of *Pag.* 16. *If I were as confident on this occasion, as you are on all occasions, I would call this a Demonstration.* Truely, were I as confident as he, I would not stick to say, I find

find no Demonstration here, but of the Vanity and Weakness of the Demonstrator.

Do but observe now, how he lyes at the Catch, how sharply he looks out, and how narrowly he goes to work for another Opportunity, to have a Fling at the Doctor. In the said *Dissertation*, *De Circulatione sanguinis per vasa minima*, against which he has made so much vain Struggle, *Pag.* 32. § 20. We have these words: *Jamque ad hanc rem illustrandam profuerit adnotasse, quod, positis vasis secernentibus orificii æqualis, sciz. quæ ex iisdem vel æqualibus locis ad similia fluida deferenda consurgunt*: Where the word *æqualis* has happen'd to be misprinted for *inæqualis*: And that poor Typographical mistake must afford us the discreet Paragraph at the foot of the *Pag.* 16. *Before I leave this Dissertation, I cannot but take notice of a slip you have made. It is the* 20 §. *where before a Proposition you premise a Supposition, That two secerning Ducts are of equal Orifices, and in the Proposition it self you suppose them to be unequal*, the quantity of Secretions being, *as you say*, proportional to the Orifices, there being nothing else to make the difference. *You have strange ways with you, sometimes you give us a Supposition in your Proposition, which is the very same with your Proposition: At another time you premise a Supposition, and immediately suppress the Contradiction of it in your Proposition.* Cou'd there, Sir, upon so little ground be any thing more spiteful and invidious, any thing more beneath the Gravity of a Scholar, or the Honour of a Gentleman?

And now, we are advanc'd to *Pag.* 17, where he begins to muster up all his Forces, only to squeeze

squeeze a little Air into the Sides of the Blood Vessels of the Lungs in Respiration. But before I come to consider the weight of the particular Arguments, I must tell hm there lyes one general Prejudice against all, or most of them; That of whatever use the mixture of Air with the Blood may be to the Animal Life, there is the less need to force it in, through disputed and controverted Passages, that fresh Supplies thereof are incessantly convey'd into the Mass of Blood, together with the Chyle, by the patent and undoubted Doors of the Lacteals. Which Prejudice is of so much the greater Force, if 'tis but a small Quantity, and that too of the finer and more subtile Air which the Libeller pleads for, as sometimes he seems to pretend no more. For when the Mass of Blood is before hand impregnated, and so plentifully furnish'd with fresh Recruits, of even the grosser Air, continually going in by the Lacteals, of what need or use can we suppose that inconsiderable Pittance more of the thinner Air, which he would have carry'd in by the Lungs? Or, if any use or purpose could be better serv'd, or cou'd any Phænomenon be better accounted for, from the Admission of a little of the finer Air, by the shorter way through the Lungs, than by the contrary Supposition, 'tis plain the Doctor has not shew'd much Disposition to Contest or wrangle with him about it. For *Pag.* 41, of his *Dissertations*, he tells us, *At quibus omnis per pulmonem devolvitur sanguis (ut in homine jam respirante fit) ea animalia statim concidunt, si excludatur non pars illa subtilior, sed aeris crassioris moles é vesiculis pulmonaribus; aeris, inquam, crassioris ea moles, quæ pul-*

monares veſiculas inflet explicetque. Let us ſee then what his Arguments prove, whether they infer any neceſſity of that little Air's ſo piercing the ſides of the Blood-Veſſels of the Lungs, or if they may not all of them be ſufficiently anſwered without that Suppoſition.

And firſt, As to the Experiment of the ſtrong Tube made of the very thickeſt Part of an Ox's Hide, which the Air paſſes through under the Circumſtances deſcrib'd, *Pag.* 17; it does not from thence follow, that it muſt pierce the two Sides of the Blood-Veſſels alſo. The Circumſtances differ in ſeveral Reſpects. We have indeed in the one Caſe a very ſtrong Tube, and in the other but very weak Membranes; but then the Force exerted upon the Membranes is far leſs than that imploy'd againſt the Tube: And were it proportionally leſs as the Strength is, or more than ſo, the thin Coats of the Blood-Veſſels would make as powerful, or a more powerful Reſiſtance againſt the leſs Preſſure of the Air, than the ſtrong Tube wou'd do againſt the greater. The Libeller does not determine the Proportion of the Forces, as he ſhou'd have done before he made any definite Concluſion, but grants at leaſt *Pag.* 18. *'Tis much ſmaller* againſt the Coats of the Blood-Veſſels, than upon the Tube, And therefore, at leaſt (becauſe I'm unwilling to exceed his own Conceſſions) The Reſiſtance of the Blood-Veſſels againſt the Air that preſſes upon them, cannot be much ſmaller than the Reſiſtance of the Tube, againſt the Air that preſſes upon it. We ſhall have enough to make up the Odds, and caſt the Ballance

lance too from other Circumſtances. For I wou'd have the Libeller to conſider, that the Reſiſtances we have been now comparing in the Tube and Blood-Veſſels, are the Reſiſtances againſt their being Rent or Torn aſunder, not againſt admitting of the Particles of Air through their Pores, which are quite different Conſiderations, the one depending upon the ſtrength of the reſiſting Bodies, the other upon the cloſeneſs of their Texture. Thus a wide Iron Grate is incomparably a ſtronger Body, and wou'd require an incomparably greater Force, to rent or break it, than a piece of fine Linnen; yet the Linnen, becauſe of its cloſer Texture, is far more impervious to the Air, than the Grate. The ſame way, tho' the Libeller's Tube is far ſtronger, and wou'd require a far greater Force to break or burſt it aſunder, than the Coats of the Blood-Veſſels, yet the laſt may be of a Texture ſo cloſe, as to be more impenetrable by the Air than the former. And that it is ſo in Matter of Fact, we have all the Reaſon in the World to believe, becauſe the Filaments of the Blood-Veſſels are exceeding ſmall and fine, and can therefore be brought much cloſer together than the courſer Filaments of an Ox's Hide. But this is not all, the little Interſtices or Pores left between the Filaments of the Blood-Veſſels are always repleted with a viſcid glutinous Subſtance, if not altogether, at leaſt more impervious to the Particles of Air, than the wider Interſtices between the Filaments of a dry'd Hide, from which all or moſt of that glutinous Subſtance is

evaporated. Nay, the Filaments themſelves of the Blood-Veſſels, from the Moiſture with which they are ſtill impregnated, are contracted in their length, and ſwol'n to the breadth. Upon which account they incroach further upon, and ſtraiten the little Interſtices between them, both in length and breadth, more than they wou'd have done without that Moiſture: While on the contrary, the Filaments of dry'd Leather, after the Moiſture is in great meaſure drain'd from them, are contracted in their Breadth, and ſtretch' to the Length, and thereby leave their Pores or Interſtices wider in all their Dimenſions, than before that Moiſture was exhauſted. The ſame Moiſture keeps the Filaments of the Blood-Veſſels alwayes ſoft and pliant, and therefore leſs apt to break than the half wither'd Filaments of dry'd Leather; which, after the Moiſture is exhal'd, are render'd ſo free and brittle, that the Leather cannot be wrought or bended into the Form of a Tube, but ſeverals of them muſt be rent and broken. So we daily ſee that all Subſtances, which are naturally full of Juice and Sap, after drying ſeparate and burſt out into a great many little Crannies, Cracks, or Flaws, that are eaſily pervious even to the groſſeſt Air. And to theſe two Conſiderations together, of the cloſeneſs of the Filaments, and the Repletion of the little Interſtices between them, is owing the Phænomenon of a blown freſh Bladder in the Air-Pump, where the impriſon'd Air has no Exit through the cloſe Sides of the Bladder, till the Air in the Receiver is ſo rarify'd, that the prevailing Elaſticity of the Air in the

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Bladder becomes too ſtrong for its Priſon-walls, and burſts them into pieces. And no doubt the ſame wou'd happen to a Piece of the fineſt Blood-Veſſel blown with Air, and ty'd at the Extremities. So that we have no Ground to pretend, that even the fineſt Air pierces its Sides, more than it does the Sides of a Glaſs-Vial, which burſts in the like Circumſtances, before the included Air can get out. Which is ſtill further confirm'd from that other Experiment of a well blown Bladder, with a great Weight in it, which tho' ſuſpended in the open Air, for all the Weight that ſtretches its Filaments, gives no Paſſage to the included Air, till 'tis ſunk under Water, where the ambient Water diſſolves the Gluten lodg'd in its Pores; which neither the included nor ambient Air will do. And the ſame way the little Crannies in the dry'd Pitch (from which 'tis never free) give Paſſage to the ambient Water into the Sheep's Inteſtines, and other Stuff, of which our Libeller's ſtrong Tube is made, which diſſolving the Gluten that is left in the Pores of theſe Subſtances, facilitates the Air's Exit through them. And as to the Force of more Moiſture in ſhutting up or ſtraitning the Pores of moiſten'd Bodies, we cannot deſire a more appoſite Inſtance, than what we have from the new way of defending the exhauſted Receiver againſt the Ingreſs of the circumambient Air, which is done by ſpreading only a piece of wet Leather upon the Plate of the Pump on which the Recipient is plac'd. And this ſo eaſy and ſimple a Contrivance affords

a better Security againſt the inſinuating of the outward Air, than any the ſtrongeſt Cement that can be thought of. For, as appears by the Mercurial Gage, no Air ſearches through the wet Leather, till the Moiſture is evaporated, tho' in a very little time it makes its way through the beſt Cement. But further, ſtill 'tis to be conſider'd, that the Blood ſtreaming through the Veſſels not only has its own ſhare, in ſhutting up or ſtraitning their Pores, but being alwayes ſtor'd with aboundance of Air, of the ſame Denſity with that which we breath in, deriv'd to it by undoubted Paſſages; the Air within has as good a Lay to be thruſt out, as the Air without to be thruſt in through the ſides of the Veſſels, by the ſame force of the Breaſt, acting at the ſame time and in the ſame way towards both Effects; nay, and a much better too, if the matter is rightly conſider'd: For the Air from within, preſſing outward, ſtretches the Coats, and enlarges the Pores of the Veſſels, by which perhaps it may get out, when the Air from without, preſſing inwards, contracts and makes the Coats of the Veſſels to ſhrink up, and thereby ſo ſtraitens their Pores, that it cannot get in. So that 'tis far more probable, that part of the Air which was in the Maſs of Blood ſhou'd be diſcharg'd from it, than that any new Air ſhou'd be convey'd to it through the Pores of the Blood-Veſſels of the Lungs in Reſpiration. Tho' from the fore-going Conſiderations all taken together, I believe neither of the Caſes happens: And I take it to be highly probable, that no Air either enters by, or eſcapes through the Pores of

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the Veſſels; I ſay, through the Pores properly ſo called, that is, the little Interſtices left between the Filaments which compoſe the Coats of the Veſſels. For there's no doubt, but that aboundance of Air is perpetually carried off from the Maſs of Blood, all the Body over, together with the Matter of other Secretions. But then that is done by the Tubes of the Secretories, and not through the Pores or Interſtices of the Filaments of the Veſſels; through which I ſee no Reaſon why the Air ſhould either paſs or repaſs, but rather think the Conſiderations I have adduc'd ſufficiently prove the contrary. Certainly the groſſer Air cannot paſs or repaſs; for if it cou'd, the Reſpiration ſhou'd be quite eluded. And I ſee no uſe for the finer. Or if the Libeller will needs have Paſſage for the finer and more ſubtile Air, I have ſhew'd, it muſt rather be out from, than into the Veſſels. At leaſt I think I have put it beyond Diſpute, that the Air's forcing its way through his ſtrong Tube is no Argument at all, why ev'n the fineſt Air ſhou'd be allow'd to make its way to the Blood, through the Pores of the Blood-Veſſels, when betwixt the two Caſes there are ſo many and ſo widely differing Circumſtances, as I have ſhew'd to the Prejudice of his ſide of the Argument, and to the Advantage of the other.

Pag. 18, The Libeller ſeems to Banter rather than Reaſon, when he prays the Doctor to 'Look 'over his Staticks, and reflect on the nature of 'Fluids, *which*, when they are preſs'd, endeavour 'to recede by all wayes from the Preſſure, and 'by that means will endeavour to get through 'the

'the sides of the containing Vessel, as well as 'through any open Orifice in it. No doubt they'll endeavour, but 'tis not the first fruitless Endeavour that has been made, as this must be, if either the Pores of the Vessel are too small for the Particles of the pressing Fluid, or fill'd with another Substance able to stand its ground against them: Which I have shew'd to be the Case of the Blood Vessels, by Arguments which the Libeller is not able to overturn. At the foot of this same *Pag.* 18. we have so excellent a Specimen of the Libeller's miraculous Talents in the Art of Reasoning, that I cannot forbear to transcribe it for the Instruction of the Reader. He tells us then (speaking to the Doctor) 'You own the 'Pressure of the Air to be so great, as to 'comminute the Particles of the Blood, and 'dissolve their Cohesions. Now, if the Sum 'of all these Pressures on the Sides of the 'Blood-Vessels, be any thing greater than the 'Sum of all the Resistances, that the Sides of 'the Blood-Vessels have to the Entrance of the 'Air, in that case there will alwayes some 'Air get into the Blood. And that the Solemnity of a fine *Calculus* might not be wanting. 'To make this Matter as clear as we can, let 'us bring it into Numbers. Suppose the Pressure the Air suffers at an Expiration, be to the 'Resistance of the Coats of the Blood-Vessels, 'as 1000 to 999; then in that Case, if the Air, 'that is forc'd out of the Lungs at an Expiration, be divided into a 1000 Parts, one of 'these will pass into the Blood, and the other

'999

'999 will go out by the *Aspera Arteria*. Was ever the like heard of? Pray, good Mr. Libeller, do you know what follows from a *Suppositio quolibet*? Suppose then, as, from what has been already said, is far more reasonable to suppose, that the Pressure which the Air suffers at an Expiration, is to the Resistance of the Coats of the Blood-Vessels (not against being rent into pieces) but against admitting of the Air through their Pores, as 999 to 1000, and then none will pass at all, but all will be thrust out by the *Aspera Arteria*, except some little quantity that remains latent in the Vesicles of the Lungs, which after the first Respiration are never again left quite void of Air.

Pag. 19. He tells us, 'That all Liquors have 'a Facility to admit the Air into their Inter-'stices —— And since the Particles of the 'Blood are divided in the Lungs, and further 'remov'd from one another, why may it not 'be allowed, that the Air being pressed, may 'get in between them? No doubt it might, if it cou'd have but Access to them through the Coats of the Vessels: But that is what the Libeller cannot prove, and which I refuse upon very good Grounds, some already adduc'd, and others to be yet added in their proper places.

As to the Argument he brings from the *Phænomenon* of the diving Bell sunk sixty eight Foot under Water, *Pag.* 19, 20, and 21. to prove, 'That the Air does not actually make its way 'through the Pores of the Membranes into all 'the Cavities of the Body, which have no Com-

‘ munication with the external Air.——For if
‘ the Air in the Bell had no Admiſſion into the
‘ Cavity of the Thorax, the Air that does there
‘ ſurround the Lungs, cou'd by no means reſiſt
‘ the Preſſure of the Air in the Bell, which is
‘ three times greater than that of the Air
‘ within the Body, which endeavours to ex-
‘ pand this Cavity; and by ſuch a pro-
‘ digious Overplus of Preſſure, the whole
‘ Ribs and Parts of the Body containing
‘ this Air, wou'd be diſlocated, or the Sub-
‘ ſtance of the Lungs torn to pieces, to
‘ make way for the external Air to enter the
‘ Cavity. For to ſhew this by Numbers, *&c.*
Surely if the Libeller had not taken care to tell us (*Pag.* 11.) *He had read ſome Geometry*, we cou'd never have gueſs'd at it from his way of Reaſoning, which we have now ſo often found ſo very Ungeometrical. Does it look like a Geometer to go out of his way for a diving Bell, when the very Air he daily reſpires can ſerve his Purpoſe as well? 'Tis true, the Air in the Bell after it is ſunk ſixty eight Foot under Water acquires a Preſſure triple to what it had before Immerſion, and exceeds that of 5000 *lib.* weight. But 'tis as true, the Preſſure of the common Air we daily reſpire is little under 2000 *lib.* weight. And, but let the the Libeller tell me, how his Body enjoying the free uſe of Reſpiration daily ſuſtains the Preſſure of 2000 *lib.* weight without feeling any great Preſſure or troubleſome Senſations, and I ſhall quickly account for the Diver's ſuſtaining the whole 5000. Hitherto I was willing to

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believe, 'twas only a little of the more subtile Air that he was pleading might have Access through the Membranes and Coats of the Vessels. But now 'tis plain from his way of Reasoning here, and from the like Stuff he has about *Harvey's* Problem, *Pag.* 25, That he Supposes the very grossest Air we breath in freely to pass and repass through all the Parts of the Body, as through a Sieve: A Supposition indeed Geometrically calculated for maintaining the Equilibrium betwixt the internal and external Air, and for preventing our feeling any uneasy Sensation from the Pressure of the outward Air. But what then becomes of Respiration? I'm afraid 'tis gone and lost for ever, and to the World's end he'll never be able to account for it, if that Supposition stands: Which leads me at the same time more particularly to consider that other Argument, Objection, Doubt or Question, or by what other Name shall I call that Stuff he has about the said *Harvey's* Problem. For what clears up that, will quickly bring us to a right Understanding of the *Phænomenon* of the diving Bell. The whole Paragraph is worth the transcribing, for the Sublimity of the Thought, and excellent Philosophy which shines in it. He tells us then, *Pag.* 25. 'Tho' in this Dissertation you (the 'Doctor) have propos'd the Solution of *Harvey's* Problem, yet I cannot see you have satisfy'd all the Difficulties that occur in this 'Matter. For I desire to know how it comes, 'that an Animal breaths when it first comes 'into the World. You say, the Air rushes into

‘ the Lungs, being preſſed by its Gravity and
‘ Elaſtick Force, as into a Place that does not
‘ reſiſt its entrance, and that this is done be-
‘ fore any Dilatation of the Thorax. But pray
‘ conſider this a little better; I think from
‘ what I have already ſaid, That all the Cavi-
‘ ties of an Animal's Body muſt be conſtantly
‘ fill'd with Air, and even the Cavities that
‘ are in the Body of the Fœtus, whilſt in the
‘ Womb, muſt have Air in them of the ſame
‘ Denſity with the ambient Air; And there-
‘ fore when a Fœtus comes into the World,
‘ and is taken out of the Teguments that in-
‘ volv'd it in the Womb, there muſt be Air in
‘ the Cavity of its Thorax, which being en-
‘ dow'd with the ſame Gravity and Elaſticity
‘ as the external Air, will reſiſt the Admiſſion
‘ of more Air. And 'tis the ſame Caſe in
‘ Animals that live in the open Air; for
‘ it will not enter the Lungs, unleſs the
‘ Cavity of the Breaſt be firſt expanded.
‘ I think therefore 'tis plain, that when
‘ a Fœtus comes into the World, that the Air
‘ will not ruſh into the Lungs, unleſs the Tho-
‘ rax be firſt dilated, which is contrary to
‘ your Aſſertion: Since then there can be no
‘ Admiſſion of the Air into the Lungs, unleſs
‘ there be a precedent Dilatation of the Breaſt,
‘ that is, unleſs the Muſcles of the Breaſt act
‘ and enlarge its Cavity, I wou'd know why
‘ theſe Muſcles ſhou'd juſt act then, and never
‘ before.

From which Paragraph it appears I did the Libeller no wrong, when I told above, that he ſup-

ſuppos'd the Air to have ſo free Paſſage through the Pores of the Body, that all its Cavities were thence repleted with Air of the ſame Denſity and Elaſticity with the external Air that environs us, when he in that Paragraph tells us, It muſt be ſo even in the Body of a Fœtus yet in the Womb, with reſpect to the Air which ſurrounds the Body of the Mother, upon which ſuppoſition give me leave now, good Mr. Libeller, to deſire you even to take the trouble upon your ſelf to anſwer your own Queſtion, *I would know why theſe Muſcles ſhould juſt act then, and never before.* For truly I know no Body that's able to do it for you. But tho' I cannot tell you why they ſhou'd *juſt then begin to act*, I can demonſtrate to you, if you pleaſe, why they *cou'd not juſt then begin to act*, but that either they muſt have been acting all along through the whole courſe of Geſtation, or that upon their firſt Action (the time of which I leave to you to determine) the Fœtus muſt have been Stifl'd in the Womb. For ſince there was all along a perfect Equilibrium between the Air in the Cavity of its Breaſt, and the external Air, together with the Waters included in the Teguments; there was nothing to hinder the Influx of the Animal Spirits, ſtill flowing from the Brain, to exert their Office in contracting of the Muſcles, which ſerve for dilating of the Breaſt, ſince the power of their Antagoniſt Muſcles in reſpect of them is ſo ſmall, that it may be neglected. The Breaſt thus dilated, either the Waters together with the Air wou'd have ruſh'd into its Cavity; in which Caſe the Fœtus muſt have been immediately Stifl'd or Drown'd, or the

the Air alone after an unaccountable manner wou'd have rush'd into the Cavity, leaving the Waters without: In which Case true Respiration must have taken place, and the Muscles dilating the Breast shou'd have continu'd to act the whole time of the Gestation, as well as after the Birth, and taking the Fœtus out of its Teguments: Which I doubt not will appear a strange Paradox in Medicine. And by the same Argument, a grown Man may breath as freely at the bottom of the *Thames*, as on *London* Bridge, and Drowning is nothing but a silly Mistake among the unthinking Populace. But to be as favourable as I can, tho' I shou'd allow, that some unaccountable Power, which all the time of Gestation had miraculously suspended the Action of the Muscles, shoud just then leave them to the freedom of their natural Action, when the Fœtus is taken out of its Teguments; to what purpose cou'd even so ample a Concession serve you? 'Tis true, the enlarg'd Cavity of the Breast might receive more Air, but that flowing in so easily every where, the Air-Vessels of the Lungs, which are of no closer Texture than the Coats of the Blood-Vessels and other Membranes, giving free passage to it through their Pores, cou'd not be blown up, and the Respiration shou'd be still frustrated, without which we all know the Animal cannot live. And is this now your Geometrical way! Because Dr. *Pitcairn* to avoid these otherwise insuperable Difficulties, as well as upon other Considerations, inferr'd there cou'd be no such passing or repassing of the Air through the Pores of the Vessels,

Veſſels, and that ſuch Cavities of the Body, as have no Communication with the open Air, muſt either have no Air in them, or but a little of the moſt ſubtile and moſt rarifi'd Parts of it, in Denſity and Elaſticity far ſhort of the common Air; Do you for that think 'tis incumbent upon the Doctor to account for Reſpiration, upon your extravagant Suppoſition, which is quite contrary to his own? And muſt you upbraid him for not having ſolv'd *Harvey*'s Problem, becauſe, tho' he has done it from far better, he cannot do it from your abſurd Principles? Truly that was your part to do, or I'm as far out in my Logicks as you are in your Geometry. But let me tell you now, had you ſeen as far into the Chain of Geometrical Conſequences as he did, you wou'd ſoon have diſcover'd the Impoſſibility of your own way, and join'd in the ſame Concluſion with him, that either there's none, or but a little of the moſt ſubtile Air in the Cavities of the Body, which have no Communication with the open Air. Which makes all to go eaſily, and to hang together handſomly. When the Fœtus is taken out of its Teguments, there being no Air, or none but what is of an inconſiderable Denſity or Elaſticity in the Cavity of the Breaſt, which ſurrounds the Lungs, the external Air, preſs'd by its far greater Gravity and Elaſticity, ruſhes into the yielding Lungs, which it immediately blows up, becauſe it has no paſſage through them, and there's either little or nothing from without to obſtruct their Diſtenſion, till they fill up the Cavity of the Breaſt, and cleave to its ſides. And now the internal Air counterpoiſing the ex-

external, the Muſcles, which before were not ſuffer'd to act for the great Preſſure that lay upon them from the outward Air, without any Ballance from within, are ſet at liberty to contract themſelves, and dilate the Breaſt to a greater Capacity, which makes room for a yet further Admiſſion of Air, and a yet greater Diſtenſion of the Lungs, till the Breaſt by its own weight ſinks down again upon them, and ſqueezes out the Air the ſame way by which it enter'd, untill again the Reſiſtance from within becomes too ſmall for the Gravity and Elaſticity of the Air without; and then begins a new Inſpiration, which is follow'd by a new Expiration, and ſo alternately till the laſt Expiration, with which the Reſpiration ends, as it begun with the Inſpiration. And thus I think I have giv'n a plain and eaſy Account upon intelligible and rational Principles, *Why the Muſcles of the Breaſt ſhou'd juſt then begin to act* (and never before) when the Fœtus is taken out of its Teguments, and how thence-furth, as long as the Animal Lives, Reſpiration muſt be produc'd and preſerv'd by a Mechanical neceſſity.

It remains only to take off that other Difficulty, which the Libeller thinks to ly ſo heavy againſt the Doctor, *viz.* That great Overplus of Preſſure, which the Body muſt ſuſtain from the ambient Air, if the Cavities which have no Communication with it, are not allow'd to be alwayes full of Air of the ſame Gravity and Elaſticity to keep up the Ballance againſt it. We have juſt now ſeen how that Counterpoiſe is provided for in the Breaſt, by a proper and peculiar

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Contrivance: As to the reſt of the Body, the Matter will be eaſily made up, if the Libeller but calls to mind what I have told him before upon another Occaſion; that the whole Body conſiſts but of one Tube, and one Maſs of Fluids propell'd through that Tube by the Force of the Heart, which is it ſelf but a Muſcle, wonderfully contriv'd and form'd for that Office from a Texture of ſome of the Ramifications of the ſame Tube. The whole Cavity of this Tube enjoys a free and undiſturb'd Communication with the open Air, not by Holes or Pores in its ſides (for extravaſated Air is as unnatural to the Animal Body as extravaſated Blood,) but by the Mouths of its extreme Branches lying open to the outward Air, freſh Supplies of which are alwayes ruſhing in by the Lacteals, (which is the only way of its Ingreſs) to make up the loſs of what is ſtill carried off by the Secretory Ducts, together with the matter of other Secretions; but chiefly by the Conduits of inſenſible Perſpiration, which in infinite Numbers terminate with open Mouths upon all the outer Surface of the Body. And this is the only way of its Egreſs. It cannot get back by the Mouths of the Lacteals, for the Flood that is ſtill ruſhing in: Nor can it re-enter by the Mouths of the Secretories, for the Stream that's ſtill puſh'd out by the *Impetus* of the whole moving Maſs: And this plentiful Influx or Intermixture of the Air renders the whole Maſs an Elaſtick Fluid. So we ſee all Animal Bodies ſwell in the exhauſted Receiver, from the Elaſtick Force of their Fluids ſtretching and expanding the Canals, when the

Preſſure of the incumbent Air is remov'd. And from the Elaſticity, in Conjunction with the great *Impetus* of the fluid Maſs, deriv'd from the ſtrong force of the Heart, and propagated and carry'd on with the Aſſiſtance of the Motion of Reſpiration, and of the Muſcular and Elaſtick Force of the Coats of the Tubes themſelves, we are furniſh'd with a Counterpoiſe of ſufficient power to ſuſtain and defend the ſides of the Tube againſt the Preſſure of the external Air incumbent upon its outer Surface: For there being ſtill a Communication perfectly free and open betwixt the external Air and the Air in the Tube, theſe Counter-acting Powers can never reſt, till they are reduc'd to a perfect Equilibration. If the Preſſure from without is too ſtrong for that from within, the outward Air will ruſh with Violence into the Cavities of the Tube, to make up that Want. If the Preſſure from within is too ſtrong for that from without, the irruent Air will regurgitate and ſtop, till the Force from within is brought down to its due Poiſe, by the Efflux of part of the redundant Air through the Secretories: And during the Struggles and Reciprocations of theſe repugnant Powers, which can never fail to happen upon any ſudden change of the Air we reſpire, the Animal cannot miſs to be pain'd with troubleſom and uneaſy Senſations, nay, and perhaps to be extinguiſh'd too, if they are violent as well as ſudden. But when that Reciprocation is at an end, or when that Change is gently and gradually made, the Animal is not troubl'd with a load of weight, or any other uneaſy Senſation,

be

because the contending Powers softly and by degrees without violence compose themselves into a state of Rest and Quiet. And so much for the Cavities of the Breast, and within the Tube. And as for those without the Tube, which have a free Communication with the open Air, as all that great Duct betwixt the Mouth and the Anus, no Difficulty lyes against them: But if there are any Cavities so closey shut up betwixt the out-sides of the Ambient Tubes, that there is no Communication left betwixt them and the External Air; in that case, the whole Elastick Force of the external Air being spent upon the Counterpoise from the intermediate fluid Mass, and solid Parts, which like so many Walls surround these Cavities, nothing is left to press upon them, but the meer weight, abstracting from the Elasticity of as many Parcels of Air of equal Dimensions with them, which is as good as nothing at all, and the weight of the solid and fluid parts, which (as I said) like Walls environ them; and these by the strength and contrivance of their Structure, are more than sufficient to support themselves. All which will find easy Credit with such as will but reflect upon a Recipient of brittle Glass, which, when exhausted of Air, tho' endow'd with no counterpoising Power, mainly from the strength of its Figure, is able to withstand, not only the weight of its own Bulk of Air, which is indeed little or nothing, but the Elasticity too, which is very considerable, producing a Pressure no less than what wou'd arise from an incumbent Column of Mercury thirty Inches high: And now from all taken together,

I think I may fairly conclude, 'tis as good as demonstrated, that tho' the Pressure of the outward Air, which we commonly respire, upon our Bodies is very great, and near equal to 2000 *lib.* Weight, yet being counter-poised with an equal Power, it can produce no troublesom or uneasy Sensation in us; being counter-pois'd, I say, by an equal Power, so easily accountable from Mechanical Principles, without running into precarious Hypotheſis's of the Air's passing and repassing at random, (through God knows what) imaginary Pores, to the intire Destruction and Overthrow of the Animal OEconomy. And now that the Respiration in the common Air is fully understood, the Difficulty from the diving Bell is discuss'd with one Breath: For if the Descent is slowly and gradually made, as the Air in the Bell is by Degrees compress, so it furnishes a more compress Air to the Lungs, and to all the patent Cavities and Vessels in the Body; by which means the Equilibrium betwixt the outward and inward Pressure is all along easily preserv'd without any danger or trouble to the Diver. But if the Descent is so quick, that there is no time left for the onveying and distributing of the too suddenly compress Air into the said Cavities and Vessels, the prevalent Violence of the outward Pressure claps the sides of the Vessels together; and the Blood, having no other way to escape, is forc'd through the Coats of the Vessels, which are burst asunder to make way for its Egress. And that which the Libeller, *Page* 21, brought as an Argument for him, proves a powerful and cogent one against him. For if the Air had free passage

every

every where through his imaginary Pores, the Air in the Cavities and Veſſels would be compreſt as faſt as the Air in the Bell it ſelf, and no Rupture of the Veſſels ſhou'd follow.

In the ſame *Pag.* 21, he adduces another Phænomenon from Animals, ‘ that are frequently kill'd ‘ by infectious Steams and Effluviums, which ‘ they draw in with their Breath; which, *he pre-* ‘ *tends*, is not to be accounted for, unleſs the Air ‘ that carries theſe Steams be ſuppos'd to mix ‘ with the Blood. He ſeems to deſpiſe the Account the Doctor gives of this Affair, from the greater or leſs Gravitation of the Air, which alwayes accompanies theſe Steams, and by which the Reſpiration is ſtop'd, and the Death of the Animal enſues. Is it poſſible (ſays he, *Page* 22) any Man ‘ can conceive that the ſmall Effluviums of Bo- ‘ dies ſhould have ſuch an effect on the Blood and ‘ Spirits, without being nearer them than the ‘ thickneſs of the Coats of the Veſſels? Your Notion ‘ about the greater or leſſer Gravitation of the ‘ Air, is no ways a ſufficient Anſwer: For it ‘ is certain, that an Animal can live where there ‘ is (*he ſhou'd have ſaid* are) much greater ‘ changes of Air as to Gravity and Levity, ‘ than what is produc'd by theſe Steams: And ‘ therefore your Anſwer is nothing to the Pur- ‘ poſe. Yes, I ſay, 'tis perfectly to the Purpoſe, and not only very poſſible, but (after the Account I have juſt now giv'n of Reſpiration) very eaſy to conceive, how either a very heavy or a very light Air, without approaching the Blood any nearer than the thickneſs of the Coats of the Veſſels, may ſuddenly kill the Animal. If

'tis

'tis too heavy, or of too great Force, it will clap the sides of the Blood-Vessels of the Lungs together: If 'tis too light and weak, 'twill not be able to blow up the Lungs. In either of which Cases the Circulation is unavoidably and immediately stopt, and the Animal presently dies: And when the Death is sudden, it is altogether impossible to account for it, as the Libeller would do, by the Quality of the Steams, which together with the Air he would have to mix with the Mass of Blood: For whether the Steams have a Quality to condense and coagulate the Blood, or to render it too Subtile and Fluid, these are Operations which require time, and do not work their Effect so suddenly, as the Death which instantly follows upon the Animal's meeting with the Steams. I don't agree with the Libeller, that 'tis certain an Animal may live where there are much greater Changes of Air as to Gravity and Levity, than what is produc'd by these Steams. That's what he ought to have prov'd, and not to have assum'd with such a saucy Assurance. 'Tis true indeed, an Animal may live under very considerable Changes of Air, but whether so considerable as is produc'd by these Steams, 'tis not so easy to determine. Nor is the Animal able to bear these great Changes, unless they are slowly and gradually made; If suddenly wrought, a sudden Period must be put to the Circulation and Life, easily accountable from the too great Levity of the Air not able to blow up the Lungs, or from the too great Gravity of it, suddenly clapping together the sides

ſides of the Blood-Veſſels in the Lungs, and thereby ſtopping the Blood's paſſage through them.

Pag. 23, He gives us one Phænomenon more of 'an Animal, *which*, when ſhut up in a cloſe 'place, with an Air of the ſame Denſity and 'Gravity with the external Air it commonly 'breaths, will die in a very little time: But 'if there be forc'd into the ſame place, when the 'Animal is almoſt expiring, more Air, without letting out any of what was there before, 'the Animal will become thereby much exhila-'rated. I know, (*adds he*) you ſay, The death 'of an Animal proceeds from the greater Preſ-'ſure and Elaſticity of the Air, occaſioned by 'the Heat of its Body: But I believe this in-'creaſe of Elaſticity can never be ſo conſiderable 'as to produce ſuch an Effect, ſince the heat of 'the Veſſel is not diſcover'd to be very great. 'And I think, I have ſhew'd that an Animal 'may eaſily live where the Preſſure of the Air 'is triple; whereas the Preſſure that ariſes from 'the Air being heated cannot be above one 'tenth of the whole. And therefore 'tis plain, 'that ſuch a ſmall Change as this can never be 'the cauſe of the Animal's Death. Beſides, 'when the Preſſure becomes greater by the In-'truſion of the freſh Air, the Animal is ſo far 'from dying the ſooner for it, that it is much 'reliev'd thereby. Excellent! Truly, Mr. Libeller, I muſt own, all your Reaſonings are of a piece, and this is no worſe than what we have had from you before. You ſeem to love your eaſe, and to prefer a haſty ſuperficial View which is got without Trouble, to that ſolid Knowledge which

which penetrates into the very bottom of Things, but is not to be acquir'd without labour and industry, in searching into their Causes and Effects, in considering them under all their different Views, in examining their Consequences, and comparing their Circumstances. Had you bestow'd some more pains this way, you might have sav'd a great deal of trouble both to your self and me; at least a very little thinking might have prevented this pitiful Objection. Put a little Animal into a large capacious Place, shut up as close as you please: Do you think for this the Animal must die? Certainly no, if it is sufficiently provided for in the other necessaries of Life. Your Phænomenon then is not universal, reaching to all close Places indifferently, but confin'd to such as are of a small Capacity with respect to the included Animal. But why, you'll ask me, shou'd the Phænomenon hold in narrow Places, and not in larger, since 'tis Air of the same Density and Elasticity that is suppos'd to be shut up in both? Why? I'll tell you, The same *Momentum* produces a greater Effect upon a less *Impedimentum*, than upon a greater. There is a greater bulk or body of Air in the one Case than in the other, and the same Animal in both. The heat of the Animal's Body endeavouring to expand the Air that environs it, cannot fail to augment its expansive or elastick Force, when 'tis closely pent up and not suffer'd to diffuse it self through the open Air; But a less bulk, by the same cause, is sooner and more intensively heated than a greater; Therefore the Air in the narrower Prisons must become more Elastick

than

than the wider: And the longer the Animal continues in the Confinement, the more is the impriſon'd Air heated; and its Elaſticity increaſes at a greater rate in a narrow than in a wider Place. The ſame thing may be ſaid with reſpect to the Gravity of the two Airs compar'd together. The ſame quantity of Perſpiration deriv'd from the Animal bears a greater Proportion, and therefore adds a greater *Momentum* of weight, to the leſs bulk of Air in the narrower Place, than to the greater bulk of Air in the wider. Let us ſee now what muſt be the Conſequence of this Diverſity; what different Influences theſe different Circumſtances muſt have upon the Reſpiration of the Animal. In the wider Confinement, the Air drawn into the Lungs in Reſpiration is comparatively of little weight and Elaſticity, and there's a great body of ambient Air, from which a ſufficient Counterpoiſe may be deriv'd by the Lacteals to the Maſs of Blood, to withſtand the leſs Preſſure upon the Blood Veſſels of the Lungs, ſo as they may incur no danger of being ſhut; when in the narrower Place, after the Lungs are inflated with a more Elaſtick and more heavy Air, the little quantity that's left behind cannot afford matter enough to the Maſs of Blood for a Counterpoiſe againſt the ſtronger Preſſure, which conſequently muſt clap together the ſides of the Blood-Veſſels of the Lungs, and ſtop the Circulation: So that 'tis demonſtratively certain we may ſo far enlarge the one Capacity, and ſo diminiſh the other, that the Animal, which muſt be ſoon extinguiſhed in the leſſer, for want of a ſufficient Counter-poiſe from with-

in againſt the great Preſſure from without upon the Blood-Veſſels of the Lungs, may live ſafely and ſecurely in the wider, (and much more ſo in the open Air,) where there is furniſh'd a ſufficient Counterpoiſe from within againſt a leſs Preſſure from without. There's no doubt, but, as the Libeller ſays, an Animal may live under a much greater Preſſure of Air than we can ſuppoſe to ariſe either from the Heat or Weight of the Air in theſe cloſe Places where the Animal dies: But that is only in ſuch Places as afford Matter enough of Air to the Maſs of Blood by the Lacteals for an internal Counterpoiſe againſt the external Preſſure. For 'tis not the Heat or Weight, or Preſſure thence ariſing, that ſimply kills the Animal, but the prevalent Force of the Preſſure from without above that of the Counterpoiſe from within. And what he ſubjoins as a mighty Addition to the Force of his Objection; 'Beſides, when the Preſſure becomes greater by 'the Intruſion of freſh Air, the Animal is ſo far 'from dying the ſooner for it, that it is much 'reliev'd thereby; is of no Force at all againſt, but rather ſerves to confirm what I have ſaid. For by the Intruſion of more Air, a greater Body thereof is provided to furniſh the Maſs of Blood with the Counterpoiſe ſo often ſpoke of. So we have here from the Doctor a Rational and Satisfying Account of the Libeller's laſt Phænomenon from Mechanical Principles. Let us ſee now what is the Libeller's.

'It ſeems to me (ſayes he, *Pag.* 24) 'That this 'proceeds from ſomething in the Air, that is ab-'ſorbed by the Blood, and when that matter is

'all

‘ all ſpent, as it muſt needs be by frequent Re-
‘ ſpiration of the ſame Air, that Air will be
‘ unfit for the further Conſervation of Life;
‘ whereas when new Air is admitted, there
‘ will be more of this Matter, which ſome way
‘ contributes to the Performance of the Vital
‘ Functions. What this Matter is, or how it
‘ operates, I will not take upon me to deter-
‘ mine. I muſt confeſs, I don't know, nor did
‘ I ever ſee any thing ſatisfactory written on
‘ that Subject. Perhaps, if Philoſophy be ad-
‘ vanc'd as much in after Ages, as it has been
‘ in this preſent, this will come to be found out;
‘ but at preſent, I ſee no way of diſcovering it.
What have we here now but Darkneſs and Obſcurity, but Words of no meaning, and Occult Qualities, ſo often complain'd of in others by the Libeller. *There is ſomething in the Air*, (he knows not what) *which ſome way* (he knows not how) *contributes to the performance of the Vital Functions*; *about which ſomething* (or nothing) *he never ſaw* (nor ever ſhall ſee) *any thing ſatisfactory written*, *but it may be found in after Ages* (Ages of Eternity no doubt he means, which is as good as never.) Is not this an excellent Speech now, and fine Reſolving! And is it not an Ingenious and Satisfactory Solution he gives of his own Phænomenon? If you'll pleaſe to hear me, I can tell you, Mr. Libeller, ſome Air is neceſſary to all Fluids, to aſſiſt in maintaining and preſerving them in their Fluidity, by thruſting in betwixt and keeping their parts aſunder: But the chief uſe of the great Proportions thereof, that are ſtill de-

riv'd by the Lacteals to the Mass of Blood, and the main way by which it contributes to the Conservation of Life, and to the Performance of the Vital Functions, is by the Counterpoise, which I have so often told you, it affords against the great Pressure of the external Air incumbent upon the Body, and rushing in upon the Lungs; without which Counterpoise the Vessels shou'd be clapp'd together, and nor Circulation nor Life cou'd be maintain'd.

The same *Pag.* 24. he falls very foul upon the Doctor for a very silly Cause. The Doctor had said §. 12. *Pag.* 48. of his *Dissertations. Ex hisce perspicuum est aerem vasa sanguifera pulmonis non subire, cum eadem* (so it is in the Doctor's Book, not *eundem*, as the Libeller is pleas'd to Print it) *post mortem animalis os non obturati mole inveniatur invase cui inclusum est, qua prius fuerat inspiratus aut inclusus.* This the Libeller complains he does not understand: But truly that's the Libeller's Fault, not the Doctor's; And 'tis hard to Reproach the Doctor, only because, when he has expresst himself very clearly, and in very good *Latin*, the Libeller has not so much Skill in that learn'd Language as to understand him: But because the Libeller owns he cannot, I'll do him the Favour to put it in *English* for him. And it is this; 'Hence 'tis manifest, that the Air does not enter the 'Blood-Vessels of the Lungs, because after the 'Death of an Animal with open Mouth in-'cluded in a Vessel, it is found of the same 'Bulk or Quantity in the Vessel, which it had 'when first blown into, or shut up into that

'Vessel.

‘ Vessel. This is the plain *English* of the Doctor's as plain *Latin*. And what is there so Mysterious and Unintelligible in either, as to deserve the unmannerly Reflexion of the Libeller, *Pag.* 25? ‘ What you have here said, you call a Phænomenon, and you take upon you to explain the Reason of it. In other Authors that write more clearly we can find out what they would prove from the Reasons they give; But it is my unhappiness here, as neither to find the Reasons, nor the thing to be explain'd by them. Truly I must agree with the Libeller, 'Tis indeed an unhappiness to be so dull, as not to understand so plain Language: And the best Advice I can give him upon it, is to revise his Grammar.

Now after so many excellent Proofs of his deep Skill in Philosophy, and the mixt parts of the Mathematicks, *Pag.* 26. he begins to shew his extraordinary Talents in the abstract Parts, *viz.* Arithmetick and Geometry: And by his profound Knowledge in these, he doubts not to fix some terrible Absurdities upon the Doctor. Our Knowledge in things of a mixt Nature often stands upon loose and slippery Foundations; and ev'n great Men may sometimes go into quite contrary Opinions about them, without any blemish upon their Name: But 'tis otherwise in Arithmetick and Geometry, where every thing is demonstratively true or demonstratively false. Therefore nothing was to be neglected that cou'd infer a Scandal of this kind. He found, as he cou'd have wish'd, his good old Friends the Transcribers and Printers

ters had furnish'd an handle from some Numbers they had vitiated in the Doctor's Calculations of the Muscles of the Breast, and of the Force of the Muscles which compress the Stomach, and of the Stomach it self: These he grasps at, and improves upon through seven Pages together, with all the Art he is Master of, with fine Rhetorical flourishes and little turns of spiteful Wit. Nay, and the Pomp of a Mathematical Figure or two must not be wanting to the Solemnity of the mighty Triumph; For now he is sure of an absolute Conquest, and that he has murder'd the Doctor's Reputation for ever.

I shall first consider what relates to the Force of the Stomach, and of the Muscles which compress it, tho' last in order with the Libeller. He tells us then *(Pag.* 30. *and* 31.) 'That 'you (the Doctor) proceed on the Princi- 'ple of *Borelli*, that the Force of all Muscles 'is proportional to their Weight, and because 'the Weight of the Muscle that bends the third 'Joint of the Thumb is 122 Grains, and its 'Force equal to 3720 *lib.* weight, and the 'weight of all the Muscles that press upon the 'Stomach is 8223 Grains: From whence you 'say, As 122 Grains to 3720 *lib.* so is 8223 to '248235. 'Tis somewhat strange, that so 'great a Mathematician as you shou'd not be 'able to work the common Rule of Proportion, 'or the Golden Rule, which every School-boy 'knows exactly. Perhaps you have some new 'way with you, or some other Notion of 'Proportion than what is founded on the Ele-

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ments of *Euclid*: I am sure, if we take the ordinary Method which I learn'd at School, the fourth Proportional to the Numbers 122, 3720, 8223, is 250734, which Number does not agree in any Figure with yours, but in the first. And when you come to Calculate the Muscular Fibres of the Stomach it self, you suppose the weight of the Stomach to be eight ounces, which is 3840 Grains; and you say, according to the preceeding Rule, the Force of the Stomach must be equal to the weight of 12951 *lib.* And here you must be exceedingly out in your Calculation, unless you have some Secrets in Arithmetick, such as you have in Physick: For, according to my Calculation, the fourth Proportional to the Numbers 122, 3720, and 3840 is 117088, which is almost ten times more than what you make it. 'Tis very true, the Transcribers or Printers have vitiated the two fourth Proportionals of the Doctor's Numbers, which the Libeller speaks of: And the Libeller has prov'd his Skill in Arithmetick by setting them at rights again. But what of all this? And why all this Banter? Because of a false printed Number or two, can nothing less content the Libeller, than that the World shou'd believe the Doctor has not so much Arithmetick as to be able to work the *Rule of Three*? Or is it possible he can think the power of his Eloquence so great, as to perswade them into that Belief? If Mistakes of this nature were to be charg'd upon Authors, how easily could I shew him the best Mathemati-

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ticians in the World daily committing the greateſt Blunders. Nay, I cou'd prove to him, That Sir *Iſaac Newton* himſelf, ſo juſtly admir'd all the World over for his profound Skill in Mathematical Learning, cannot work the common Rules of *Addition* and *Subtraction* in whole Numbers, which are Operations far leſs perplext than the *Rule of Proportion*. But what wou'd the Libeller ſay, if I ſhould have the Impudence to undertake to prove upon himſelf, that he cannot multiply the little Number 15 into it ſelf? For (*Pag.* 20, *Lines* 4 and 5) twice over he has for the Product 125, when every School-Boy knows it is 225. What *Euclid* was it that taught him to compound the Square of a Quantity conſiſting of two Parts, only from the Squares of theſe Parts? Certainly the true *Euclid* who wrote the Elements, con'd have told him, *Book* 2. *Prop.* 4. that the two Rectangles of the Parts were to be adjoin'd to the Squares of the two Parts to compleat the Square of the whole. If he pleads 'tis the Printer's fault, not his, why ſhou'd he grudge the like favour to Sir *Iſaac Newton*, or to Dr. *Pitcairn*. But to pleaſe the Libeller to his Heart's deſire, let us ſuppoſe the faults of theſe Numbers to have proceeded from ſlips of the Doctor's own in the Computation of them: Where is the Hazard of his Reputation? Is there ever one that deals in Numbers, but is conſcious to himſelf, how ordinary and how eaſy a matter it is to fall into Miſtakes and Overſights in all ſorts of Calculations? Nay, I appeal to the Libeller, if his own Conſcience does not tell him that he finds it ſo himſelf in his daily Practice

It is likewise true (as the Libeller observes *Pag.* 32) that the Doctor did only consider the absolute Force of the Muscles which compress the Stomach. But since that is so great, as to exceed the Pressure that wou'd arise from the weight of 91 large siz'd Milstones, nay of near the double of that Number; (For it must be acknowledg'd, there is indeed a greater Oversight in this matter than the Libeller was aware of, the Doctor having taken into the Account the Muscles only of the one side of the Abdomen, intirely forgetting those of the other:) I say, since the absolute Force of these Muscles is so prodigiously great, there is Room enough for large Deductions, upon the account of the Obliquity and Contrariety of their Actions, so as to leave sufficient Force behind for the Attrition of the Aliment. And the Doctor, satisfy'd with the general View of that vast Power, did not attempt to make an Estimate of the particular Deductions to be allow'd upon the mention'd accounts, as a Task next to impossible. The Libeller may try his hand upon it if he pleases.

As to the Numbers which regard the Breast, from what is left sound and unmangl'd in that Paragraph, 'tis easy to see the faults are plainly Typographical. The Paragraph is *Pag.* 57 of the *Dissertations*: *Pectus hominis est sphæroïs, cujus diametrus minor sit plerumque in majoribus digitorum quindecim. Ostensum est ab aliis, dilatato pectore axem minorem augeri, majori interim non diminuto, adeoque cavitatem amplitudinemque pectoris majorem evadere. Sit augmentum diametri a spina dorsi ad sternum pertingentis centesima pars digiti,*

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eritque augmentum cavitatis pectoris digitorum cubicorum 31: *tantumque aeris accipere potest accipietque pectus eousque dilatatum, ut ejus diametrus minor aucta fuerit centesima digiti unius. Similiter si diametri minoris augmentum sit digiti quinquagesima, haurientur aeris digiti cubici* 62. *At si augmentum diametri sit quingentesima pars digiti, erit augmentum cavitatis thoracicæ digitorum sex: & si fiat augmentum tantum millesima pars digiti, cavitas augebitur digitis tribus: tantumque aeris ad explicandos pulmones haurietur, adeoque tantillum explicari poterunt. Unde patet posse aliquam respirationem institui, licet augmentum diametri pectoris sit admodum exile, motusque vix visibilis.*

Let the Candid Reader consider the Paragraph, and judge whether the Libeller had Reason for that impertinent Question *Pag.* 27, 'How come 'you to determine the Increase of the Cavity, 'by having only one of the Diameters of the 'Spheroid and its Increase? What *Archimedes* 'taught you this? *&c.* I'm wearied with his reviling and foul Language, and shall only gravely tell him, An honest Man wou'd have presently concluded, the other Diameter was omitted by the Printer. For since there were definite Numbers assign'd for the Augmentations of the Cavity, it was plain, they had been computed from two definite Diameters, and definite Augmentations of the one, without which given it was impossible for any created Being; why should I say impossible for any created Being? It was a manifest Repugnancy and Contradiction to the nature of Things, to have brought out any definite Numbers, true or false, for the augmentati-

tations of the Cavity. The omitted greater Diameter was 20 Inches, which with the Augmentations of the Cavity 31, 62, 6 and 3 Inches, ſtanding as aſſign'd by the Doctor, plainly ſhew that the numbers expreſſing the ſuppos'd Augmentation of the leſſer Diameter have been ſpoil'd by the Printer, and that the Paragraph ſhou'd be thus read. *Pectus hominis eſt Spherois, cujus diametrus minor ſit plerumque in majoribus digitorum quindecim*, major vero diametrorum viginti. *Oſtenſium eſt ab aliis, dilatato pectore axem minorem augeri, majori interim non diminuto, adeoque cavitatem amplitudinemque pectoris majorem evadere. Sit augmentum diametri a ſpina dorſi ad ſternum pertingentis* decima *pars digiti, eritque augmentum cavitatis pectoris digitorum* 31, *tantumque aeris accipere poteſt accipietque pectus eouſque dilatatum, ut ejus diametrus minor aucta fuerit* decima *digiti unius. Similiter ſi diametri minoris augmentum ſit digiti* quinta, *haurientur aeris digiti cubici* 62. *At ſi augmentum diametri ſit* quinquageſima *pars digiti, erit augmentum cavitatis thoracicæ digitorum ſex: Et ſi fiat augmentum tantum* centeſima *pars digiti, cavitas augebitur digitis tribus.* &c.

But ſtill the Libeller will inſiſt upon his fetch'd Conſequences, and contend it will hence follow, That, upon his Principle *Pag.* 29. of *a Man's Length* being *commonly more than ſextuple of the Cavity* ('Tis the firſt time I have ever head *Length compar'd to Cavity*, but no doubt he means the *Length* of the *Cavity*) *of the Thorax*, I ſay, upon that Principle, he'll ſtill plead it will follow, that the Man muſt be ten foot High: and from the meaſure of his Breaſt, that it muſt

be sufficient to hold ten Gallons of *English* Wine-measure. And no doubt it does follow. But what then? He'll tell me, that the Doctor has assum'd one, or both of his Diameters too big. Truly Mr. Libeller, if that will please you, I'm sure the Doctor will never refuse you the Concession. And I dare swear that in all this Matter there was nothing less in the Doctor's Thoughts than a Geometrical Determination of the Capacity of the Breast, as it really obtain'd in the humane Body, which was nothing to his Purpose: For his Business was quite another thing, *viz.* to shew, 'That 'the Capacity of the Breast might be so en-'larg'd as to receive a quantity of Air suf-'ficient to maintain a small Respiration, while 'the Augmentation of its Diameters were so 'inconsiderable, that the liftings and fallings of 'the Breast might escape the Observation of 'our Senses; Which he has as effectually done from the two Diameters of 15 and 20 Inches assum'd at Random for an Example, as if he had made use of the true Diameters taken by Rule and Compass from the humane Body. For 'tis a general Rule in similar Bodies (as 'tis reasonable to believe the dilated Breast is to the Breast before Dilatation) that their Capacities increase in the Triplicate Proportion of their Diameters or Homologous sides; And consequently the increase of the Capacity may be considerable, when that of the Diameters is not sensible. And the same Consideration may serve for an Answer to his Cavil about the Sphæroidical Figure; For perhaps an Elliptical

Conoid

Conoid comes nearer to the true Figure of the Breaſt: But the Doctor's Reaſoning holds as well in the Conoid as in the Sphæroid, and any rude Approximation was enough to his Purpoſe, and he takes the Sphæroid as the more ſimple and better known Figure, and in that Spheroid does not aſſert, but aſſume the Diameters to be 15 and 20 Inches, as his Words *Cujus diametrus minor ſit*, not *eſt*, plainly imply. I believe in large ſiz'd Men theſe Diameters are rather generally about 8 and 12 Inches. In which Caſe the Man's height, by the Libeller's Rule, will be about 6 Foot, and the Capacity of the Breaſt (conſider'd as a Spheroid) will be about 14 *Engliſh* Pints, which is no exorbitant meaſure: And ſuppoſing each of theſe Diameters to be increas'd but by one fiftieth Part of an Inch, the Cavity will be inlarg'd by 3 Cubical Inches, which is a pretty large Allowance for a ſmall Reſpiration, when the riſing or ſubſiding of the Breaſt but to one fiftieth part of an Inch cannot be perceiv'd by our Senſes. And thus, for all the Noiſe that was made, not one Propoſition of the Doctor's is overturn'd, nor one flaw found in any part of his Reaſoning. And while that ſtood unſhaken, what a ſhame was it to fall a nibling and catching at a few miſprinted Numbers! That was a Play for Children, and not an Imployment for a Man of Senſe and Character. And when he has ſhew'd ſo keen a good Will to wound the Doctor's Reputation, and yet was able to ſay nothing, but ſuch trifles, I think he has left the Doctor's as ſafe as he found it, and only injur'd, I ſhou'd rather have ſaid, done Juſtice upon his own. But

But the Doctor must not be suffer'd to go till the Libeller gives him the parting Blow, and 'tis hard to tell, whether it shou'd provoke more our Indignation or our Pity, to see one who knows nothing at all of the Practice of Physick, in a matter of Practice so impudently attack one of the best Practitioners that's this Day in the World; one, who from a Rational and Demonstrative Theory has establish'd a no less Rational and Demonstrative Practice, one who from his happy Success has gain'd to himself a Reputation that is not to be shaken; whom the Sick cannot want, the wiser Physicians study to follow, and none envy but the Ignorant and Unskilful. This Charge is against that excellent *Dissertation, De curatione Febrium quæ per evacuationes instituitur*, which he tells us *Pag.* 34, is *the only practical Dissertation in all the* Doctor's *Works*: As if the rest, tho' of a more speculative Nature had no Influence upon Practice. If he had understood Physick better, he had judg'd after another manner.

At first outsetting, he tells us *Pag.* 34, *we must have Patience till we hear of your acquaintane with* Steno, *and a touch at your own Praise.* I shall transcribe the Sentence from the Doctor's own *Dissertations*, *Pag.* 121 §. 4. that the Reader may judge whether there was Ground for that invidious Insinuation. It is this; *Nos autem Dissertatione de Circuitu sanguinis per vasa minima, quamvis fermenta hæc in corpore animalis ostenderimus non inveniri, tamen ut eorum captui consulatur, qui demonstrationem non capiunt, libet rem omnem vel tyronibus intelligendam dare. Ex iis,*

quæ

quæ verbis Stenonianis *hic descripta sunt, liquet quari*, &c. Is there any Vanity, any Immodesty or Ostentation in these Words? Or any thing like the saucy dogmatick Air, which the Libeller so often puts on upon far less occasion?

In the same Paragraph and the following, he proceeds to give an Account of the greater Probability which the Doctor alledges for the going off of Fevers by Secretion at the Skin, than any other Secretion, which tho' he endeavours to Represent in a ridiculous way with a Q. E. D. subjoin'd to the tail of it, is still good Sense, and as sound Practice.

The Affair is plainly thus; That after Blood-letting and Vomiting in the Case of a Fever, the Doctor sayes, 'tis more probable the Crise must happen, and that it is therefore a more reasonable Practice, to promote the Scretion by the Skin, than any other Secretion.

That the Doctor presuppose's Blood-letting and Vomiting is evident from *Pag.* 119. where he sayes, *Nos de Coctione illa tantopere celebrata non disputamus, sed solum inquirimus, quænam evacuatio vel secretio deberet eligi, si ulla foret eligenda. In hac investigatione prorsus silebimus de curatione quæ instituitur per sanguinis missionem, quoniam decrevimus eas tantum evacuationes inspicere, quæ per vias naturaliter patulas in animali sano emergunt, quasque medici moliuntur post celebratam venæ sectionem, vomituque pectus purgatum, si opus est, opus autem est sæpissime.*

After these Operations are over, he observes first, That the Solutions of Fevers are carry'd on by Secretion at the Skin by the Glands of the Kidneys,

Kidneys, and by a Diarrhæa. His words are *Pag.* 123, § 6. *Observatum esse diximus solvi febres aucta secretione cuticulari, aliquando vero aucta secretione per glandulas renales, vel inducta Diarrhæa, per hepatis, pancreatis aut intestinorum glandulas. De aliis Crisеos generibus non opus est loqui, nisi forte quis icterum febri aliquando supervenientem superioribus velit adjungere.*

Secondly, He observes that there is no matter of Secretion, but what may be carry'd off by any Glands of the Body, ev'n by such as are principally destin'd for other Secretions, which he proves to excellent good purpose in the few following words of the same *Pag.* 123, *Deinde observamus nulla esse vasa secernentia, nullasque in corpore nostro secretioni inservientes glandulas, quæ non possunt augeri in tantam amplitudinem, ut pares sint accipiendo secernendoque cuivis humori etiam in aliis glandulis secerni naturaliter apto. Quippe animadvertimus in ictero liquorem illum crassum, qui naturaliter secernitur in glandulis hepatis secerni in cuticularibus, & nimium saliva per suas glandulas proventum cohiberi sudore evocato, & liquore salivali eliminato per glandulas cuticulares: videmus diarrhæam sedari averso humore in vias transpirationis sudorificæ vi apertas, & ptyalismo excitato otiari alvum, excitata vero cursus diarrhæa cessare ptyalismum, qui etiam, veluti aliæ secretiones, tollitur urina accedente profluvio.* And, as he proceeds § 7, *In febribus præsertim observare licuit, quam sæpe quivis liquor per quasvis vias ducatur artis aut naturæ vi dilatatas, quamque nulla sit febris cui similis soluta non fuerit oborta secretione per glandulas sudoriferas, sæpius quam ulla alia secretione: adeoque nullum esse genus materiæ febrificæ, quod*

quod non possit duci per glandulas transpirationi dicatas, &c.

And therefore the Libeller was egregiously in the wrong, when he tells us *Pag.* 35 'Before 'we proceed, I must tell you, that your second 'Observation is very ill supported by the Par- 'ticulars you alledge in its favour, tho' it serves 'you to no great purpose at present, if it were 'really true. For the Observation spoke of could by nothing be better supported than the adduc'd Considerations, and nothing could be more pat to the purpose intended. As to what he subjoins in the same Paragraph; 'More- 'over, your Expression about Secretion shews 'how little you know of that Affair; but as 'this has been done already at greater length, 'I shall only observe how widely you differ from 'Dr. *Cockburn* on this Subject; yet he must 'needs be oblig'd to you for his Doctrine. Read 'him again, and you'll find your changing 'Hands of Secretions very absurd; as also 'that your Circular Ducts of different Diame- 'ters help us very little in the case of different 'Secretions. I don't know what possibly he can mean by the Doctor's *changing hands of Secretions*; For the Doctor has said nothing here upon that Subject in the least differing from the Account he had given of that matter before in his *Dissertation, De circulatione sanguinis per vasa minima*: About which I need add nothing here to the ample Defence I have already made: And where Dr. *Cockburn* differs from him, it is such Stuff as is not worthy to be consider'd.

Laſtly, The Doctor finds by Computation, that the Secretion by the Skin is no leſs than double or triple of all the other Secretions together, and more than decuple of that by Stool alone.

From all which he concludes, That as the ſuppreſſion of the one half or third part of the Secretion by the Skin may generate a Fever equal to that which the Suppreſſion of all the other Secretion together would produce; And as the Diminution of the Secretion by the Skin, to but a tenth part, wou'd bring on a Fever no leſs than what ſhould be occaſion'd from a total Suppreſſion of the Belly: So the Augmentation of the Secretion by the Skin will be of as great Effect in carrying off a Fever, as the double or triple Augmentation of all the other Secretions together, and the increaſs'd Secretion by the Skin will be of no leſs moment, than the Secretion by the Belly alone augmented to a decuple Proportion. And was there ever a more rational or natural Concluſion? And could one have believ'd the Libeller ſo weak, as to think he could have overturn'd it by the naughty Account he was pleas'd to give of it?

'But to leave this, (ſays he *Pag.* 35) let us 'advance with you in your further Diſquiſition 'in the ſubject of Fevers: The next Enquiry 'then is, how much, and in whatm anner this 'Blood is chang'd or alter'd in time of a Fever. 'In order to reſolve this uſeful Queſtion, ſome 'Experiments, you ſay, may be proper, that 'ſhew the nature of the Fever-matter to be 'ſuch, as may paſs by any Veſſel. But, once

'more

'more, these Experiments are really so proper
'and material, that you think fit to put off the
'Disquisition at this time; especially that you
'seem to be of Opinion, that it may be fully
'satisfy'd by shewing what Proportion the na-
'tural Secretions have to one another. How so-
'ever improbable this Medium seems to be, yet
'we are willing to learn, how, by the given
'Proportion of Natural Secretion, the Disposi-
'on and Aptitude the Fever-Matter may have
'to pass indifferently by any of the Secreting
'Vessels. But in stead of the Demonstration,
'all this Account is turn'd into a pitiful Com-
'parison of *Sanctorius's* Experiences, by the help
'of a little Arithmetick; tho' *Huygens* must
'be brought into the Scene upon account of
'the Chance that this Fever-Matter may have
'to pass rather by the Skin, than at any other pass-
'age of Evacuation. Had it not been more proper,
'first to have answer'd your Question, and to have
'told us the nature of the Fever-Matter; then your
'Arithmetick might have found a place to shew
'us the odds of this matter being voided at the
'Skin, and at other parts? But your new
'method of Demonstration is to beg the Questi-
'on, and to fall foul on your Adversaries. On
'the other hand, if you'll allow a little of your
'liberty to Dr. *Brown*, one Supposition for him
'will conclude all you have said more powerful-
'ly against you, than your many Suppositions
'make for you. Suppose then this Fever-Matter
'or Ferment is in a very inconsiderable quantity
'in the Blood, it will thence follow, that it may
'be soon discharg'd by Stool or otherwise; and
'far more certainly that way, than by the

‘ Skin; the means for producing that Effect be-
‘ ing more constant in their operation. This one
‘ Consideration of a greater Certainty at once
‘ determines the choice of any prudent Person.

Was there ever such Stuff heard of! What more proper or material Experiments wou'd he have than these already adduc'd and above cited from the Doctor *Pag.* 123 of his *Dissertations* (which for the Libeller's sake I shall here repeat in *English*) shewing, ‘ That the Bile,
‘ one of the thickest Fluids in the Body, which
‘ is naturally secern'd by the Glands of the
‘ Liver, yet in the case of a Jaundice is carry'd
‘ off through the dilated Glands of the Skin;
‘ That the natural Secretion of the Spittle is
‘ lessen'd by raising Sweat, and deriving part
‘ of it through the Cuticular Glands; That a
‘ Diarrhœa is abated by diverting the Humors
‘ into the ways of Perspiration enlarg'd by
‘ Sudorificks; That a *Flux de Bouche* hinders
‘ Excretion by the Belly, as the Excretion by
‘ the Belly stops or diminishes the Flux at the
‘ Mouth, which also, as well as all the other Se-
‘ cretions are lessen'd by a more than ordi-
‘ nary Evacuation of Urine. If these Obser-
vations don't prove that all sorts of Secretions may be brought to pass through all Glands, I know nothing can. And being so, the Doctor's Computation makes it plain, the chance for passing by the Skin is no less than Decuple of the hazard for passing by the Belly. The Doctor was blam'd for the loosness of his Numbers before, and 'tis hard he shou'd be now challeng'd for the Accuracy of them.

What

What the Libeller talks of the nature of the *Fever-Matter* or *Ferment* is such Stuff as shews he knows no more about the nature of a Fever, than he does of the Animal OEconomy. Doctor *Pitcairn*, in Compliance with the way of speaking of those whom he refutes, makes use indeed of the word *Materia Febrifica* or *Fever-matter*, but plainly insinuates there's no such thing; and that Fevers proceed from Obstructions or Dilatations of the Glands, that is, from the Diminution or Augmentation of the Secretions carry'd off by the Glands above the natural Proportion observ'd in Animals of sound Health, as the learn'd Dr. *Cheyn* has shew'd more at large. The Supposition he makes for Dr. *Brown*, That his inconsiderable 'Quantity of *Fever-matter* or *Ferment* may be 'soon discharg'd by Stool or otherwise, and far 'more certainly that way, than by the Skin, the 'Means for producing that effect being more 'constant in their Operations; Is altogether silly and ridiculous: For we can easily suffer our Perspiration to be augmented to the decuple of its ordinary Proportion, when 'tis impossible to stand out against an hundred fold Evacuation by the Belly. And Dr. *Pitcairn* has demonstrated the one is but equivalent to the other. What Stuff is it he talks about *Certainty and Constancy in producing Operations*? Can we not as surely produce a strong Sweat as a strong Purge? If he knows not, any Apothecary's Boy can inform him. And for all he has said, the Prudence of the Choice still lyes upon the Doctor's side.

'Tis

'Tis not worth the while to take notice of what the Libeller laſtly objects, *Pag.* 38. from the Operations of *Lenitive Medicines*. For, from the View I have already given of the Animal Body, 'tis manifeſt the Inner Surface of all that Canal which reaches from the Mouth to the Anus is as much external to the Animal as the outer-Skin; And the waſhing or augmenting the Perſpiration of the one, is much the ſame thing with the waſhing and augmenting the Perſpiration of the other: And the concluding Quibble about *Lenient Medicines* and *Gentle Purgatives* in favour of Dr. *Brown*, is of a piece with the learn'd Criticiſm about the word *Denſus* with which he began. And in a word, all that he has ſaid about Fevers is ſo extremely ſilly and Childiſh, that I'm truly aſham'd to have taken ſo much Notice of it.

And now, Sir, I'm affraid I have tranſgreſs'd upon your Patience, as well as wearied my ſelf with an ungrateful Subject. If we are to have more Works of this nature, I wiſh the Author may write in *Latin*, and there will be little need of a Reply: For it may be preſum'd, ſuch as are learn'd in that Language may be able to judge for themſelves. Or if he muſt rather do it in *Engliſh*, becauſe he underſtands that Language better than the *Latin*, if he wou'd but forbear his *Billings-gate*, and learn to write in a more civil way, he ſhall be ſure of as civil a Return. And for my good Friend Dr. *Pitcairn*, I wiſh he may haſten the new Edition of his *Diſſertations*, which is ſo much long'd for by the Learn'd both at home and abraod

abroad. And I do assure him, their own Merit will preserve them a lasting Book to after Ages, when the Libeller's Paper shall be quickly spent upon its proper Uses, which for decency's sake I forbear to name.

I am,

SIR, &c.

ERRATA.

Pag. 17. *Lin.* 1. *Lege.* YR. RZ. *l.* 3. *Lege* YRZD and ſo *l.* 6. *L.* 9. *Lege* FΠH *p.* 34 *l.* 11 *dele* two. *p.* 41. *l.* 33. *dele* not.

A Translation of the 83, 84, 85, & 86 *Pages* of Dr. *Pitcairn's* Dissertation, *De legibus Historiæ naturalis*, Printed at *Edinburgh*, *Anno* 1696.

IN the Year 1695, *William Cockburn* published his *OEconomia Animalis*, in which there is nothing at all that's new, but what he hath taken either from *Laur. Bellini*, or from me: Tho he hath not the Manners to mention either of us in his whole Book. All that he writes to the 17 *Page*, on *Chylification*, is mine; save only that he hath intermix'd these common Things concerning the Action of the Teeth, and the use of the Spittle: Not adverting, that I had purposely past over these, my Design being only to treat *of the Motion by which the Meat is reduc'd to a liquid form in the Stomach*, or of *the Action of the Stomach*, as I name it in the 2d Paragraph of that Dissertation.

But *Cockburn's* 39 and 40 *Pages* contain nothing but what is stoln out of the 66 *Pag.* of *Bellini's* Book, *De Urinis, pulsibus*, &c. of the *Francford* Edition 1685. The 41 *Pag.* is taken out of *Bellini's* Preface to that Work. The 42, 43 and 44 are copied from

the 112 of the same Book, and the 45 from the 67. The 46 answers to the 72 and 69 of *Bellini*. Again the 47 is excerpted from the 73, and the 48 from the 74 and 73 of the same Author; and the 49 is mostly from the 65 *Pag.* For he jumbles and confounds them together after an odd manner. The rest of the 49 is intirely copied from what I dictated to my Scholars, without so much as the change of a Syllable. The 50 *Pag.* is wholly taken out of the 74 *Pag.* of *Bellini*'s Book. What he has of the Temperaments is mine. For he hath faithfully transcrib'd my Dictates. The 55 and 56 *Pages* are from the 1, 2 and 3 of that Book *De Urinis*, and that so faithfully, that not so much as the Marginal Notes could escape being brought into his Book. The 57 is carefully stoln from the 7 of *Bellini*'s, *De Urinis*. The 58 is intirely out of the 7 and 8, as are also the 59 and 60. *Bellini's* 12 *Pag.* hath furnish'd this Plagiary with his 61 and 62 *Pages*. He might with the same Confidence have borrow'd his 63, 64, 65, 66, and 67 from the same Book of *Bellini*: But he chose rather to express them in my Words, as I explain'd *Bellini's* Thoughts to my Scholars: For what Reason I know not,

not, if it were not that he thought that a Thief ſhou'd often change his Quarters.

At laſt in his 68, 69, and 70 *Pages*, he falls about the Solution of a Problem by his own Strength; For, alace, *Bellini* was now far away, having written nothing of that Matter: And ſo *Cockburn* pitifully Blunder'd, tho otherwiſe the Problem may be very eaſily ſolv'd.

His 73 *Pag.* is patch'd up out of my *Diſſertation, de Circulatione ſanguinis in animalibus genitis & non genitis*, Printed at *Leyden Anno* 1693. His 82 *Page* alſo, wherein he magnificently explains the uſe of the Spleen, has nothing in it, but what is in the ſecond Corollary annex'd to that *Diſſertation* of mine. The ſame Corollary with the third following hath ſupply'd *Cockburn* with his 84 *Page*.

What follows concerning *Secretion* is wholly pillag'd from that Work of the great *Bellini*: All that he has upon *Reſpiration* is either taken out of *Bellini*, or my *Diſſertation*, which I made to explain *Bellini's* Thoughts, and publiſh'd at *Leyden*, *Anno* 1693.

And that nothing of *Bellini* might eſcape his plundering Clutches, he publiſh'd a Book on *Sea Diſeaſes*, wherein he

wou'd have the World believe that *Bellini's* Discoveries in the Matter of Fevers are his own Inventions. And so by this time he has almost wholly copied over *Bellini*, who yet after all is above the Reach of his Comprehension.